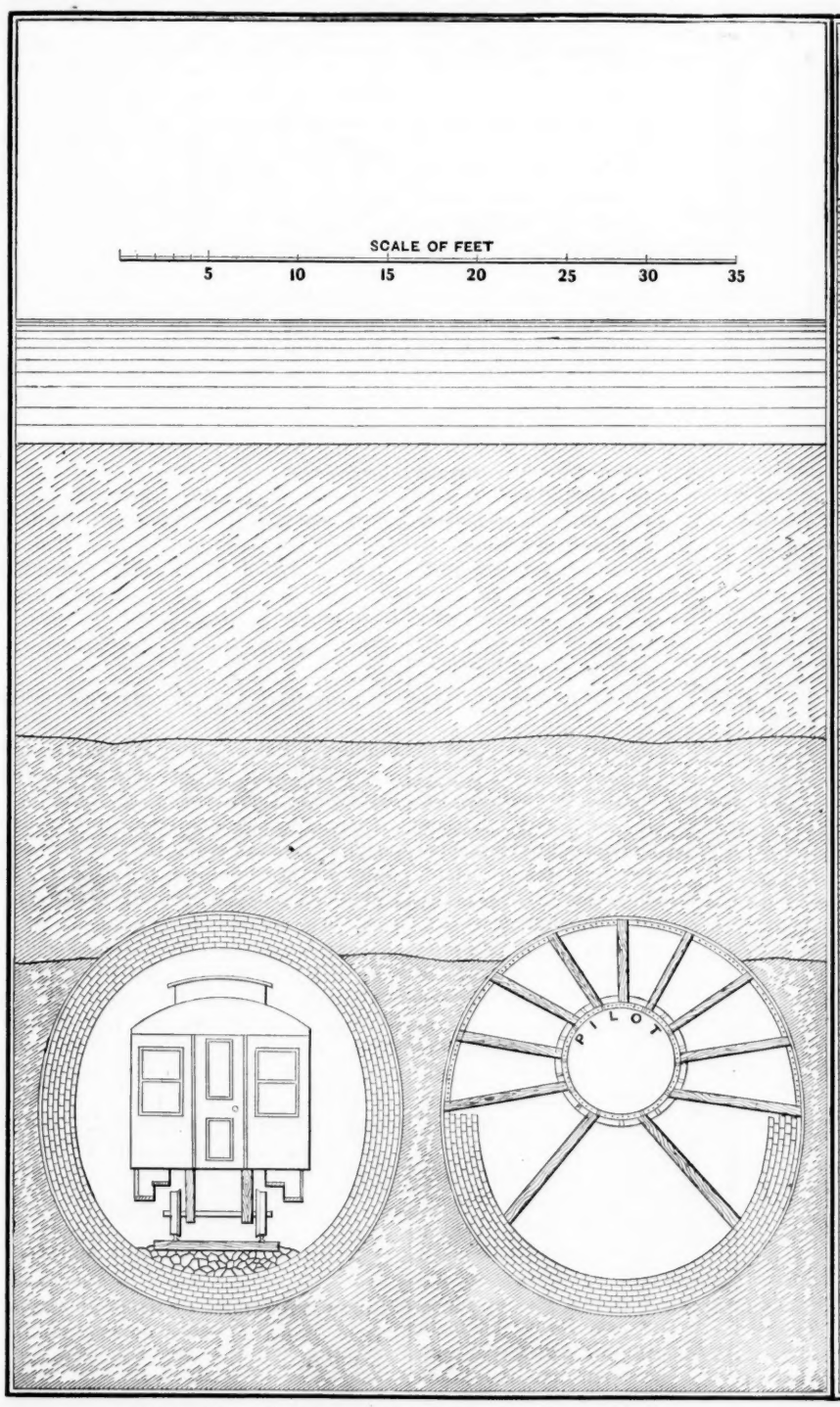
AMERICAN MACHINIST

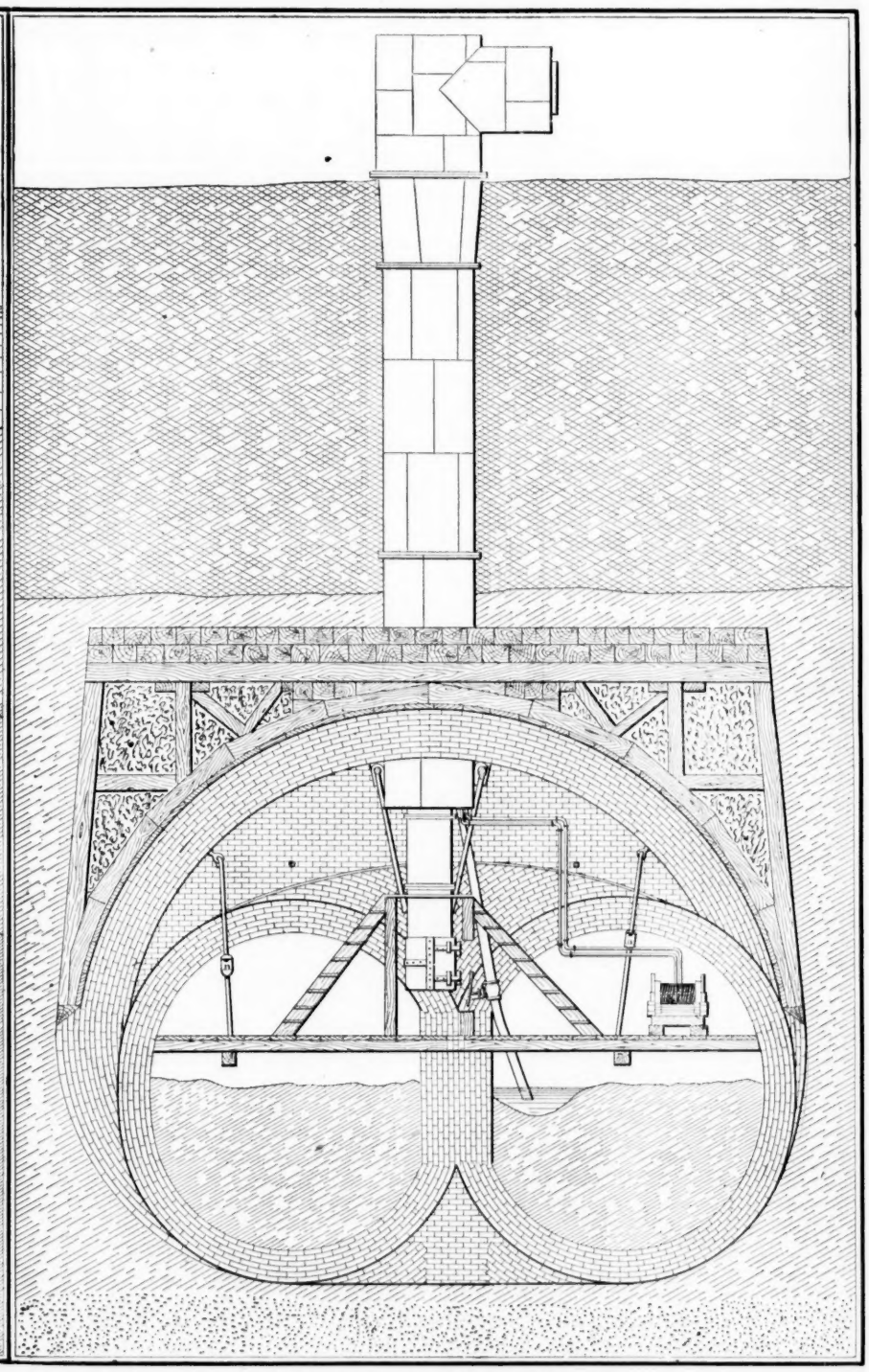
A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 4, No. 17. WEEKLY. | NEW YORK, APRIL 23, 1881. | $3.00 per Annum. SINGLE COPIES, 6 CENTS.

COPYRIGHT, 1881, BY AMERICAN MACHINIST PUBLISHING COMPANY.—ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MAIL MATTER.



SECTIONS OF TUNNEL COMPLETED AND UNCOMPLETED.



SECTION THROUGH END OF CAISSON.

New Methods of Driving the Hudson River Tunnel.

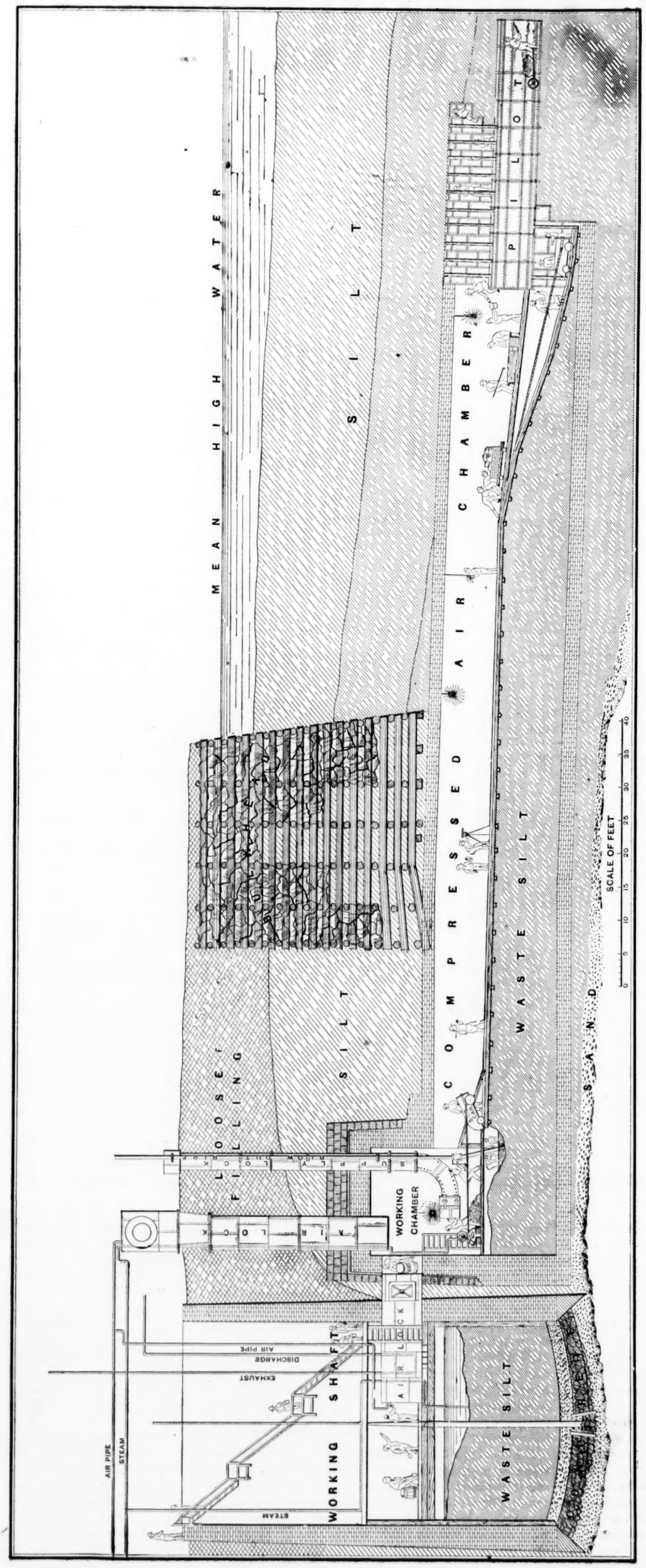
In our issue of August 21, 1880, we severely criticised the methods employed at the Hudson River tunnel, in endeavoring to push forward the work. We also, at that time, condemned all other devices for reaching the bottom of the tunnel except a caisson, and advocated that as the only feasible and reliable means of opening up the works, which were filled with mud and water at the time of the accident. We will describe the new methods adopted for driving the tunnel, and give an outline of the progress of the work up to the present time. Our readers will remember that after the accident, which occurred July 21, 1880, the attempt was made to pump the water out of the shaft. This failing, they built a coffer dam which for its purpose was also a failure. However it afterwards proved to be well worth the trouble and expense of building, for the protection and advantages it offered in sinking the caisson, which was built after all other means failed. The caisson was built of timber and strongly braced. The inside or roof was of a circular shape, intended, when the ends were cut out, to cover both tunnels, which it afterwards did, as shown in the accompanying engraving, representing one end of the caisson removed and looking towards the river.

After the caisson was completed, it was lined with asphalt cloth covered with sheet lead. The air pipes being connected, an air pressure of 5 lbs. per square inch was found sufficient to drive the water out, down to the shoe of the caisson. On Sept. 13, 1880, the work was begun with an energy which has characterized it ever since.

After cutting away timber which obstructed the downward progress of the caisson, it gradually sank until the plates of the collapsed arch, forming the top of the tunnel, were reached. From this time (Sept. 22) broken plates were discovered and removed. The tunnel about the air-lock was filled with soft mud, which was washed in by the water from the river, hence there was great difficulty experienced in making connection with the old air lock. This was, however, effected by cutting through the end of the caisson, pushing out plates, and supporting them by angle irons spiked to the caisson.

An effort was then made to enter the south tunnel (which is shown at the right in the illustration), but the mud was so soft that it allowed the water to flow in so freely that little or no progress could be made. A brick support was then built for the shoe of the caisson, as shown on either side of the tunnel. Thus the caisson was finally sunk, notwithstanding the predictions to the contrary of many expert engineers. A hole was cut through the east end of the caisson in the center, and in line with the top of the bridle plate connecting the two tunnels. The silt was removed through this hole, and plates were pushed out one at a time, and were supported at one edge by resting upon the bridle plate and following the same curve, while the other edge was spiked to the caisson. In this manner the arch was finally completed.

It was found that the water had washed all the mud out from under the bulkhead, and that the water could not be prevented from coming in, so a temporary bulkhead was erected at the entrance to the south tunnel, and silt was forced into the space by the air pressure, and thus stopped the leak. A three inch pipe was used for directing the



LONGITUDINAL SECTION OF HUDSON RIVER TUNNEL, SHOWING METHOD OF CARRYING ON THE WORK.

balls of silt to the desired locality, and in sufficient quantity to fill the space. The leak being stopped, the next step was to complete the excavation below the shoe, lay the inverts, and complete the bottom and sides of each tunnel. The inside of the caisson was also bricked up as shown.

The middle wall between the two tunnels was carried up only half way, thus making the caisson a large working chamber, accessible by two air locks from the outside, and communicating freely with both tunnels. One of the vertical air locks was used for introducing and removing working material, and the other for the workmen. After bricking up the inside of the caisson it was given a coating of Portland cement.

An examination of the tunnel proved that the work was not injured by the accident, and remained as when the work ceased. Steps were taken at once to reach the south tunnel, but on a different plan from any used heretofore.

In forcing an entrance, the silt, which was very soft, frequently gave way, and a six-inch pipe was used for introducing silt to stop the leaks. It often required four men to feed the pipe with balls of silt, which were carried through by the air pressure. Serious difficulties were encountered continually, until, through the ingenuity of Superintendent Andersen, the idea of a pilot tunnel was suggested and put into practical operation. This tunnel, as shown by the engraving upon this page, consists of a tube six and one-half feet in diameter, and is made of stout iron plates four feet long, using ten plates to complete the circle. The top of the pilot tunnel occupies a position about six feet from the top plates which form the main tunnel. Plates of iron are put into the joints between the ends of the plates, and, projecting about six inches, form flanges which prevent the pilot from creeping.

The object of the pilot tunnel is to advance from thirty to forty feet ahead of the main tunnel, to form a reliable support for the plates of the main tunnel. These plates are supported by braces extending from the pilot to the plates, also shown by the engraving. The braces have screws at the ends, by means of which they may be easily adjusted.

Since the adoption of the pilot tunnel there has been very little difficulty in producing almost true circles. The main heading is advanced in sections of ten feet, the plates being bolted together at the top first, and afterwards at the bottom; the circle is then bricked up and finished. The silt is loaded in cars at the headings, and drawn by an engine to the caisson, where it is dumped. It is then mixed with water, and by opening a valve the silt is blown out by the pressure of the air into a hopper, from which it runs into cars and is finally deposited well up on the shore. This process requires only one handling, viz., when taken from the heading.

A working shaft for sending down bricks will be observed in the accompanying engraving. The lower door being closed, the bricks are introduced at the top. The door is then closed, the air turned on, and when the pressure within the air lock is equalized with that in the tunnel, the lower door is opened and the bricks fall out, as shown. The other vertical air lock is still used for quick communication with the tunnel, or for one or two persons wishing to enter the tunnel, while the large horizontal air lock is in use, especially as it wastes much less air. The total length of the tunnel from one shaft to the other, when completed, will be 5,550 feet. There are at present over 200 men employed, which are divided into three gangs, working eight hours each. The air pressure in the tunnel is forty-four one-hundredths of a pound per square inch, for each foot of water, making an average pressure of about twenty-one and one-half pounds per square inch. This pressure is made to vary with the tide in the river.

The south tunnel, as shown, is now finished 450 feet from the shaft, while the north tunnel is finished 300 feet. The electric light is used, which is considered indispensible, for if the light goes out for an instant the small light given by candles is entirely insufficient to allow the work to proceed.

The engraving represents the workmen engaged in their work, and the engineers in running a line. Distances can be readily ascertained by a use of the scales attached to the engravings.

Preparations are being rapidly made for pushing forward with the north tunnel, which has lain idle since the accident. This will give employment to about fifty more men. The resident engineer is E. H. Burlingame, who directs the practical engineering; and engineer Lovejoy has charge of the New York end of the tunnel. A space has been enclosed at pier 42, foot of Morton St., New York, for sinking a shaft similar to the one in Jersey City. Machinery is being put in position at that point, and the work is being pushed forward. The progress now made is from three to four feet per day.

Extracts from Chordal's Letters.

BEAUTY AND UTILITY OF MECHANICAL DRAWINGS—EIGHT METHODS OF REPRESENTING A BOLT.

Mr. Editor:

* * * * My last letter, regarding features in mechanical drawing, was not intended as a criticism on the features themselves, but upon the idea of many of them being applicable to use in the shop; as between draughtsmen, many of the plans for developing fullness, proposed in your columns, are admirable, and would be readily acceptable. As previously stated, the machinist is not a draughtsman, and drawings for his use should be so made as to convey intended ideas without the necessity of educating the man, who may already be all he has need to be—a skilled artisan.

* * * * The piece which has been used in your columns in illustration—a simple collar bolt—is hardly a fair one to illustrate my idea, because it delineates a familiar shape, and, however the drawing be made, but little room is left for conjecture. The true test of a drawing's perfection would be to show a previously unknown shape, and see how the sample ma-

chinist translated the drawing, or how many questions he asked.

* * * * The element of beauty in a drawing I am not considering. I am one of those who think that a thing is none the worse for being handsome; but in the matter of drawings, as in other articles of utility, if the cost of the luxurious part tends to reduce the quantity of necessary part, I think beauty may be handled very lightly with good results.

* * * * In matters of beauty, we are often apt to overlook the effect which will be produced when some necessary thing is added afterwards. The architect, admiring his front elevation, says to himself, that the drawing looks handsome, and calls special attention to the elegant and well-lighted detail of some complicated first story frieze.

A sign on the building, or an awning, covers this frieze or darkens it, and gives to the building and the drawing an entirely different appearance.

The draughtsman admires his handsome detail shop drawing, and says he hates to spoil it by putting dimension figures on it; and when he does get his figures on, he says he might just as well have saved all the labor put on the adornment, for all the good it does. Just so.

And then the machinist puts one coat of dirt, and two coats of scratches on the drawing, and the draughtsman's pride in his product is completely gone. Machine shop drawings are no place to gratify pride of process.

* * * * Neatness of shop drawing will enhance the neatness of the work done from the drawings. A ratty looking drawing, which conveys the idea that the draughtsman wasn't certain about what he wanted, will generally result in indifferent work.

* * * * This sketch shows our bolt in simple outline.

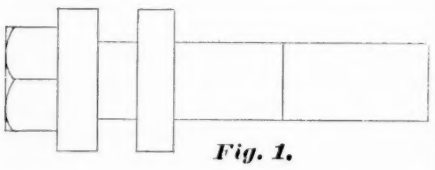


Fig. 1.

It is the plainest and easiest made form of drawing. The bolt is so familiar that any kind of a drawing will explain it, as before stated, but the following questions are likely to arise, and the drawing gives no information: 1. Is the head to be square, or hexagon, or octagon, or what? 2. What is the line across the body for? Is the lathesman to scratch a line at that point, or is the part on one side of the line to be round and the part on the other side square, or something, and if so which part is to be which?

We may safely say of this drawing that it don't tell half enough.

* * * * One of your correspondents speaks of the flatness of such drawings as Fig. 1, and calls attention to the merit of such a drawing as this:

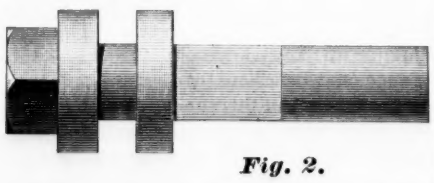


Fig. 2.

Here we have light and shade, and fullness and beauty. The thing stands right out, and anybody can tell the shape of things. With all its merits this thing has faults, both as a drawing of a bolt and as an illustration of the advantages of "shaded drawings." As a bolt drawing it don't tell whether the head is square or hex. There are shoulder shadows in it which appeal at once to the artist, but which are bad for the green machinist. He sees "things" on this drawing which he don't understand. Is he to cut notches at the black places, or what?

The thing is a fraud anyhow, for it is no drawing at all. It was engraved in a ruling machine. The man don't live who can counterfeit it with drawing instruments. It is no example of shaded drawings.

* * * * When a fair draughtsman—one who understands his business—undertakes to make nice shaded drawings, here is what he produces:

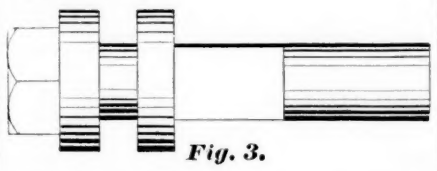


Fig. 3.

This is not a bad job of such work. Where is the life in it, the shape, the projection, the beauty? True, it lacks the usual flatness, but it is simply a plain drawing, complicated by technical lines which convey no meaning outside the knowing ones.

* * * * Mr. Webber contributes this sample:

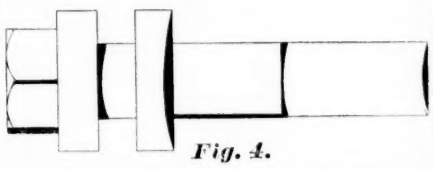


Fig. 4.

and claims that it furnishes "unmistakable evidence as to which part is round." I am able to disprove this. Such a drawing, cut away from explaining text, cannot be translated by even the average draughtsman. The plan is an arbitrary technicality. As such it may be admired, but for the shop it is not a bit superior to no system of shading at all. The drawing must be explained before the stranger within our gates can tell what is round and what is not round. Mr. Webber kindly explains his sketch in his letter.

* * * * Mr. Otto Fuchs sent you a drawing, based on a new plan, and sent with it a rule for translating drawings so made. Here is the bolt on his plan.

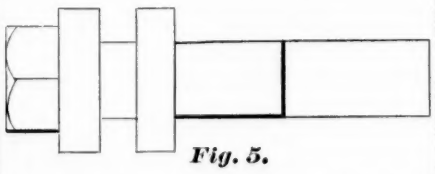


Fig. 5.

I omit to copy the rule here, and leave the system to explain itself, which I think it will fail to do.

* * * * This drawing (Fig. 6) shows how an ordinary draughtsman applies shadow lines.

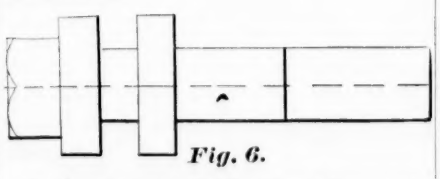
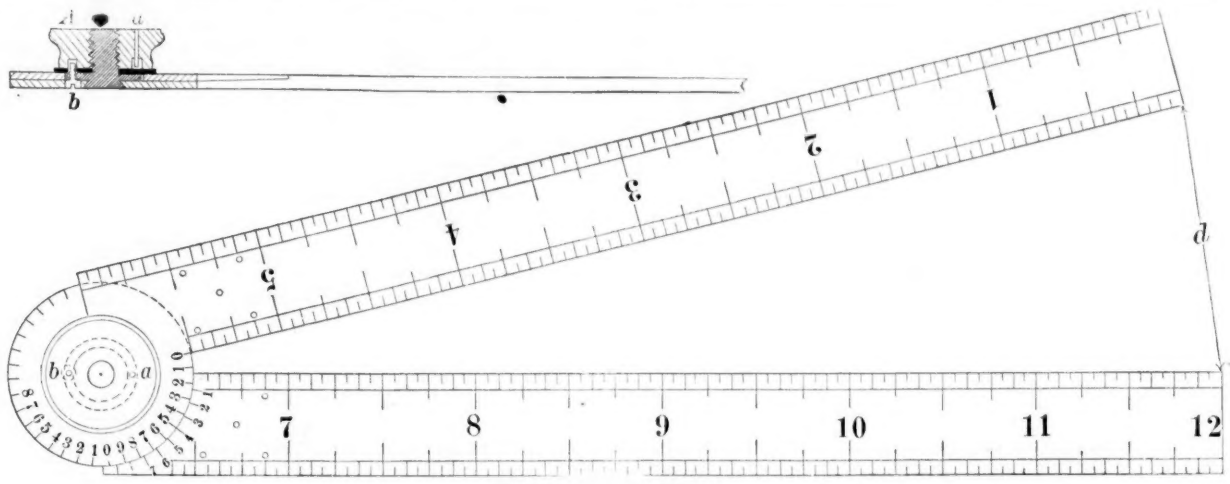


Fig. 6.

The lines are applied by the arbitrary rule of the craft. They tend to liven up a drawing, but don't convey the least particle of information to the user, who, in most cases, don't know that "light," and "direction of light" are elements in drawings; and to one who does understand these things, the lines do not in the least aid in defining the shape of the piece. These lines do no good, but they have the merit of not doing any harm. There is a dotted line through the center, which is neither useful or beautiful. If you ask a draughtsman why he puts a center line in such a thing as this, his intelligent answer will be "Why not?"



Draughtsman's Bevel.

* * * * Now we have it. Here (in Fig. 7) is Mr. Carter's plan. As a shop device it has most decided objections.

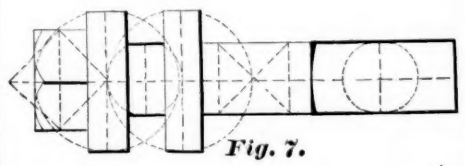


Fig. 7.

In the first place it fails in its mission, like all arbitrary plans, when it goes into the shop; and in the second place, it is a crazy-looking drawing, well calculated to make the average machinist believe he can't make the thing; and that it can't be made in a lathe by anybody. Working drawings should be made by the golden rule; use only those lines which outline forms, or define forms or dimensions.

* * * * Pencil, crayon, stipple and brush shading, like hatching, or the novel kinks above referred to, tend to enlighten the uninitiated who need it the least. Such shading tends to beautify the drawing and its fun for the draughtsman. If it does no good in the shop it does no harm, which is more than can be said about some of the things here shown.

* * * * Everybody knows of the schoolboy's drawing having explanatory notes—"This is a horse," "This a man," &c., &c., attached.

The aforesaid schoolboy plan is the best plan I know of for detail drawings. The object of a drawing is to convey information.

* * * * I submit a schoolboy drawing

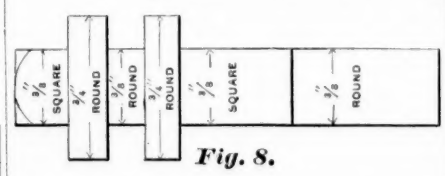


Fig. 8.

of the bolt, and respectfully ask if directions for use are required.

Very respectfully,

Chordal.

Draughtsman's Bevel.

By John W. Nystrom, C. E.

The draughtsman's bevel, described by Mr. W. B. Cogswell, in the American Machinist for April 2, page 6, is a very useful instrument, but too little known among draughtsmen.

The accompanying illustration represents one made by myself at the Royal Technological Institute, Stockholm, about 36 years ago, which is carried out a little further than the one made by Mr. Cogswell.

The hinge, which is one inch in diameter, is graduated into an angle vernier, by which the legs can be set to any desired angle, and read for every degree in the half circle. On the illustration, the legs are set to an angle of 14°. The numbers on the inner circle, 1, 2, 3, etc., mean 10°, 20°, 30°, etc., up to 90°, after which 0 means 100°, and 1, 2, 3, etc., mean 110°, 120°, 130°, etc., up to 180°. The vernier on the outer circle shows units of degrees, where the division coincides with that on the inner circle.

The divisions on the circles must be made in a good dividing engine, making the vernier on the outer circle 10 parts in the quadrant, and on the inner circle 27 parts in the three-quarters of the circle. If properly made, the legs can be set to fractions of a degree.

The nut *A*, is for clamping the legs after the proper angle is set, and the bevel can be handled without disturbing its adjustment.

A groove is made in the underside of the nut, for the pin *a*, and screw *b*, for the purpose of preventing the nut from being unscrewed more than necessary, for setting the legs. The screw *b*, is put in after the nut *A*, is screwed on; and the pin *a*, stopping against the upper end of the screw *b*, prevents the nut from being unscrewed more than required.

The hinge is made of brass, and the legs are made of box wood, cemented and riveted to the hinge. I have forgotten what kind of cement was used, but it seems to answer very well.

The legs are each six inches long, making twelve inches when unfolded straight. The bevel now in my possession, and made at the Royal Technological Institute, Stockholm, is of Swedish measure, which is shorter than that of the English.

The bevel, as represented on the drawing, is divided into inches and sixteenths, of which the inner division is for scale measurement, namely: the distance *d*, is set to the desired scale of six inches, that is, when the scale is to be one-quarter, then the distance $d = \frac{1}{4} \times 6 = 1\frac{1}{2}$ inches. For a scale of one eighth, $d = \frac{1}{8} \times 6 = \frac{3}{4}$ of an inch, and so on for any desired scale. For any desired measure counted from the center of the bevel, the cross measure parallel with *d*, is the scale measure.

When the angle of the legs is required to be more correct than can be relied upon by the vernier, it can be obtained by the aid of a trigonometrical table, and the distance *d*.

Call v = angle of the legs, then distance $d = 12 \text{ Sin. } \frac{1}{2} v$, angle $\text{Sin. } \frac{1}{2} v = \frac{d.}{12}$

Example 1. Required the distance *d* for an angle of $v = 36° 26'$? $\frac{1}{2} v = 18° 13'$. $\text{Sin. } \frac{1}{2} v = 0.31261$. Distance $d = 12 \times 0.31261 = 3.75132$ inches.

Example 2. Required the angle of the legs when the distance $d = 4.375$ inches? $\text{Sin. } \frac{1}{2} v = \frac{4.375}{12} = 0.3646 = \text{Sin. } 21° 23'$. Angle $v = 42° 46'$.

When a scale of a foot, divided into decimals, is at hand, no calculation is required for the distance *d*, which can be read directly from the trigonometrical tables; for instance, in the first example the distance $d = 0.31261$ of a foot, showing the advantage of the decimal system.

It would be advisable to have a diagonal scale of decimals of a foot engraved on the underside of the bevel.

A bevel of this kind is very useful on the drawing board for laying out correct angles, and for reversing the same, as described by Mr. Cogswell.

It is to be hoped that some mathematical instrument maker will take hold of this bevel, and manufacture the same for the market.

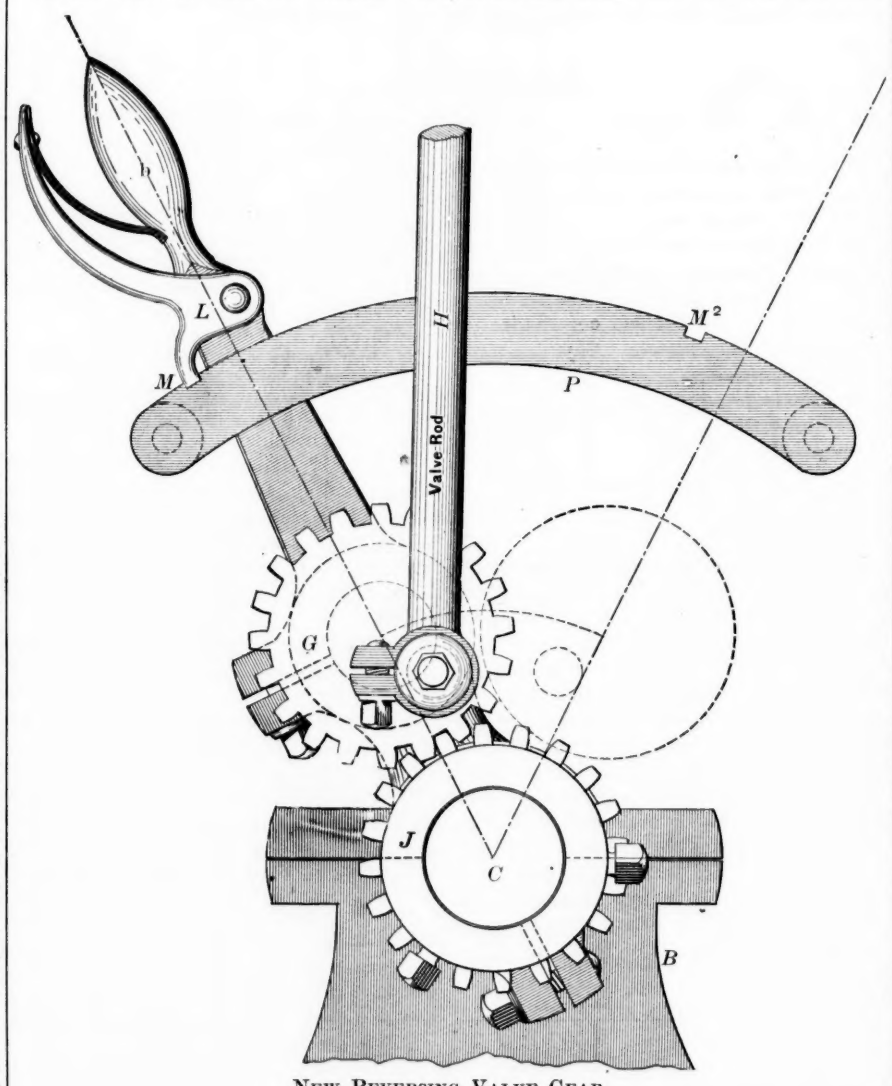
New Valve Gear.

The cut on this page represents a new reversing device for valve gear as applied to a vertical engine, which, although but recently brought out, has been adopted to quite an extent by agricultural engine builders for their traction engines.

Unlike most of the link substitutes, it does not require that the engine be stopped in order to reverse, but may be handled under any and all circumstances, and is positive in its action.

In the cut, *B* represents the pillow block, and *C* the main driving shaft of an engine. The arrangement consists in the combination with the main shaft of an engine, and the valve rod thereof, of two intermeshing gear wheels of equal diameter, one fixed on the main shaft and the other mounted on a lever, fulcrumed to the main shaft, and connecting with the valve rod by a wrist pin (no eccentric used), in such manner that the last mentioned wheel may be thrown to either side of a line on the plane of reciprocation of the valve and the main shaft center. To reverse the engine it is only necessary to throw the lever to the opposite side of the central line, when the position of the movable wheel will be as shown by dotted lines, and the wrist pin will assume the proper angular advance for a reverse motion.

It is made by Marsh, Lefevre & Co., Battle Creek, Michigan.



New Reversing Valve Gear.

Theory and Practice.

By F. F. Hemenway.

I have been trying to work up the problem of how much of theory and how much of practice it takes to run an ordinary machine shop. I had read considerable of theoretical mechanics, and theoretical management as opposed to practical, but never invested much in the way of considering the matter, and got badly mixed. I got down to definition, and got more mixed right away. I don't believe there is an individual in the country who can give a definite, off-hand definition of the term, as used in connection with matters mechanical. I used to be disposed to give up a great deal to theory for the sake of the term. It sounds nice; it has a sort of aristocratic jingle, that seems to get above greasy waste and overalls—a peculiar sanctity, as who should say, "You can't set me down as one of the vulgar crowd." I've honestly tried to find it, and get it in first, and work it up to the loftiest summit—in fact, do anything that would separate it from things common, but it won't work. You may separate it, and set it apart, and distinguish it as with, but not of, in some other business for all I know, but you can't do it in the machine business. In that business you have to get it right down to the level of planing, and turning, and scraping, and drilling; you have to hammer at it, and with it, and get it at both ends of a monkey wrench, and litter up the shop with it, and clean the shop out with it. It will go into the cupola, and it will put other things into the cupola, and get into the same place at the same time with your best workmen, and stalk about in overalls and skull cap, and walk around in broadcloth, and a beaver. You can't shut it up in the drawing room, and you can't shut it out; and it will get into communion with your youngest apprentice.

* * * * * * *

Suppose you were to build a steam engine; you would proceed to design, and if you were not clear in the matter, you would determine what strain the proposed material would safely bear, and you would determine this from some one's theory; or rather, you would find out from the record of some one's practical operations of squeezing, and twisting, and pulling, and bending. You would read just as you would read the "History of the United States," or "The Last of the Mohicans;" a record of the observed effects of these manipulations made by a practical man, in a practical manner, with practical mechanical appliances, and with the usual accessories of grease and waste, and overalls over store clothes. There wouldn't be a particle of theory about it, so far. If you were a thoroughly practical man, the theory would begin to come in here, and you would supply it. You would reason if wrought iron would safely stand a tensile strength of 10,000 lbs. to the square inch, and a certain part of your machine that was to be made of that material would be subjected to 25,000 lbs., and some jar and irregularity, you ought to make it 4 inches in section, and so along through the other parts. You would work up to your conclusions from experiments made under entirely different circumstances, and for general purposes; and it would be all theory on your part that converted these general records to your specific purposes, notwithstanding you are probably one of those who don't believe in theory.

* * * * * * *

When you got along to friction, you would consult Professor Thurston's theory—only, the professor don't seem to have any theory on the subject. If he had, it would probably be quite as good as any other—that is, not worth much. He has furnished the mechanical world with the records of some very valuable experiments, made in the most practical manner, and through exceedingly practical appliances; and it is interesting to note that these records—overturning as they do many accepted *theories*—are more valuable than others that have gone before, because there isn't any theory about them. You wouldn't have a journal of the exact dimensions, running at the same velocity, and under the precise load of his experimental journals; and you would reason up to your conditions from his experiments, and this reasoning process would be all the theory there was about it. Others' practice would have taught you that the theory of the expansion of steam was a snare, and a delusion, and you would get the best record of their practice, and modify it a little to suit your conditions, and add a little theory on your own account; and when you had that engine designed, all the practical part of it would be the work of others; and all the theory would be yours; and you started out to design a steam engine without any theory about it! When you turn those drawings over to your practical pattern maker, who never made patterns for a steam engine in his life, he will reason right up from something he has made, and his reasoning will lead him to certain conclusions which will be pure and unadulterated theory. If he reads up a little on the subject of steam engine patterns in general, that will constitute the practical part of his knowledge of what they should be. Your moulder will go through the same process of reasoning, and reading, perhaps, and the result will be that when the castings are laid on the floor of the machine shop, they represent practice, and they represent theory; and you can't charge up these items separately, because you can't tell where one begins, or where the other leaves off. Your best machinist never bored a cylinder for a steam engine, nor turned a piston, nor finished a connecting rod; but he has bored, and turned, and fitted other things into the condition of a good job; and his practice will tell him how to use tools, and his theory will tell him where to use them; and you will get a great deal more of theory, bored, and turned, and drilled, and scraped, into that engine, by the time it gets through the machine shop. By and by you will correct some of the detail, and your theory of this year will crystallize into your practice of next year. You can follow your fathers, and save theory, but you can't devise or invent anything without it. You can't, whether proprietor or workman, help along in the smallest degree, the mechanics of the world, without it.

* * * * * * *

If you run a regular anti-friction manufacturing establishment, you employ a systematizer to wind it up; and in the process of running down, certain gauges find their way through certain parts, and certain parts find their way through certain gauges, and there isn't a great deal of theory about it. It all comes in in the winding up process. After a time, those parts that have gone through, and been gone through, fail to connect, and it will take considerable theory to get them around to a proper condition of connecting. If you run a regular jobbing shop, and have to follow the usual practice, good work from poor tools, and poor work from good tools, the case is different from the beginning. There isn't enough machine literature published, if it were all devoted to that special purpose, to explain how to get a tip-top job out of an old cranky lathe. There is a good deal of theory needed for that single purpose, that isn't published, and that won't be printed till new characters are invented. Some of it wouldn't sound well. You can't find practice or precedent for it, because there never were two old lathes that followed any precedent in their crankiness. I used to believe in the interchangeability of the terms "Theoretic" and "Book" mechanics. I don't do it any more. I find practice in printed matter, and I find practical men furnishing the theory. The more practical they are, the more theory they have. Some one has to do a good deal of reading and study to keep a machine shop abreast of the times in this year of grace. You have to know a good deal of the practice of other people. You have to change and modify your practice to keep it alongside the march of knowledge. You can't change or modify your practice without the aid of theory. You may get a good deal of your practice second hand. You have to manufacture the most of your theory for the occasion. It has to fit in round holes that are not round, and in square holes that are not square. It has to suit this job to the conditions, and those conditions to the job. You will find your best workmen full of it, and crying out against it. You will find your poorest workmen without any, and bragging about it. I don't know whether a genuine machinist is a practical theorist or a theoretical practiser.

LETTERS FROM PRACTICAL MEN.

Taking Care of Steam Boilers.

Editor American Machinist:

In a late issue you encouraged the writing of communications from Practical Men. I am glad to see that you do so, and wish that practical men would avail themselves of your invitation to a greater extent than they do. Myself and many of my friends value the American Machinist on account of the many practical articles it contains. My friends say of a certain article: "We can understand it fully. It goes home to us. It is practical. That article I read last week in the American Machinist is worth to me ten times the subscription price." That's the way they all talk.

I think occasional articles, advising engineers how to act in emergencies; also, how to avoid accidents of various kinds, what parts and fittings of engines and boilers to watch closely—all these would be appreciated by the young engineer, and do much good, perhaps preventing loss of life and property.

Let me cite a case or two: A young engineering friend came to me the other day for advice. Said he, "My boiler has been acting queer the past day or two. The water jumps up and down in the glass-water gauge, and occasionally disappears. It appears again, and fills the glass, and I, thinking the boiler has sufficient water, stop the pump, only to find it goes out of sight in a few minutes. The tubes leak so badly that I can scarcely keep up steam or water in the boiler." My friend had just taken charge of the job a day or two before calling on me.

The engineer whom he relieved (an old hand at the business) told him the tubes leaked, and that the water in gauge acted curiously, but assigned no probable cause. I asked him about the water-gauge connections, and he told me they were half-inch pipes, top and bottom. I told him the pipes were entirely too small for safety. I advised him to take them out and put in one-inch pipes, and in place of elbows, use tees with plugs in end-opening of tees, so by removing the plugs, he could thoroughly clean the pipes every time he washed out the boiler. He called to see me next day; said he had removed the lower pipe of his water gauge, and had found it almost entirely stopped

with mud and sediment. He replaced the old pipes with larger ones, using tees with plugs as described above, and finds everything right, and water level steady. He examined the back end of tubes, and found the head on the two top rows burned off. The tubes had been red hot! It seems a miracle that this boiler did not explode. It is in a public institution, and had it exploded, the loss of life would have been dreadful.

I desire to mention another case: I was consulted as to the probable cause of the water level varying so much in a tubular boiler. The engineer said it would rise in the glass water gauge six or eight inches. I investigated, and found the steam pipe to water gauge was connected to the main steam pipe for heating the store. When the main steam valve on above pipe was opened, of course it lessened the pressure on the steam pipe to water gauge, and the water rose in the glass, and there was apparently too much water in the boiler. I advised placing the pipe leading to top of water gauge in the top of boiler, free from all other connections. Since the change has been made, there has been no further trouble. The water level is very steady.

Glass water gauges are good things to have, and quite convenient, but they are not infallible, and should be watched closely. I know of places where engineers have in use the common ordinary glass tube water gauge, and they never think of blowing it out occasionally. I have seen the glasses so dirty and begrimed, that the engineer would have to look quite sharp to see where the water was. I have visited places where entire dependence was placed on the water tube, there being no gauge cocks in the boiler, or other means of knowing the height of water in the boiler.

There should be at least *one* good gauge cock in boiler, and the pipes and connections to water gauge should be blown out thoroughly *every day*, and critically compared with gauge cock, and if there is an appreciable difference, the difficulty should be found at once. I would advise comparing the height of water in glass tube and gauge cock in the morning, before the fires are started under the boiler. ENGINEER.

St. Louis, Mo., March 28, 1881.

Position of the Blacksmith.

Editor American Machinist:

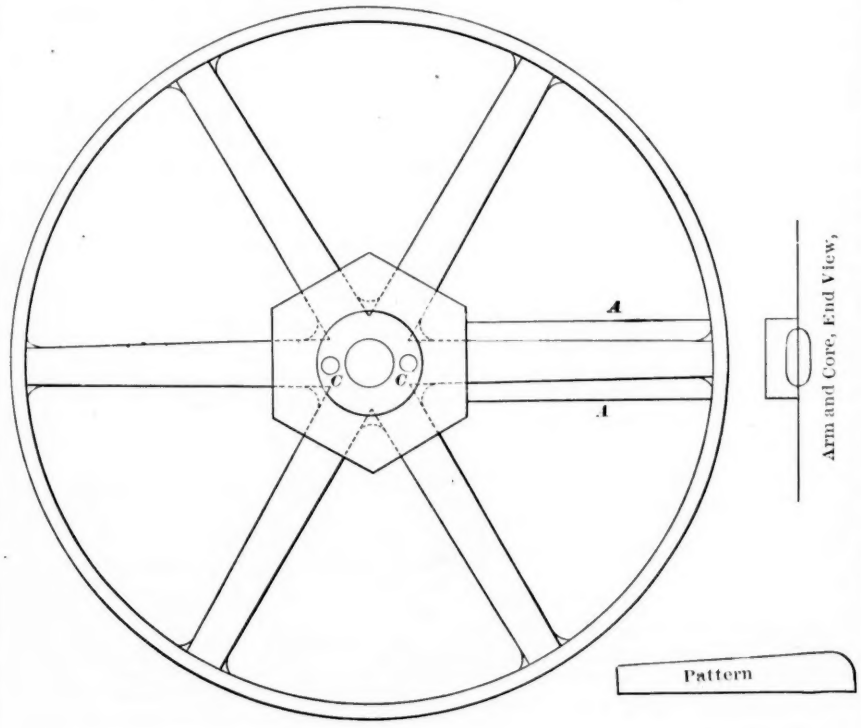
In your issue of April 2d I read an article on the wages of draughtsmen and foremen, signed J. P. Workman, Arlington, N. J. I don't agree with him in the assertion that the blacksmith or machinist is inferior in any respect to either moulder or pattern maker. In the first place, the blacksmith requires more than the "varied skill" of the pattern maker, because he cannot glue a piece on here or saw a piece off there if the job don't happen to come just right. In the second place, the blacksmith is as much superior to the moulder as the moulder is to the casting cleaner. Why? A moulder requires no eye for form, which is indispensable in a blacksmith; a moulder does not work to drawings, a blacksmith must do so in most cases. Oft-times he has to work from an oral drawing, and in ninety-nine cases out of every hundred he succeeds. The artistic moulder wants a pattern every time; no pattern, no job. Granted that the change of water affects the tempering of sand in making a good clear casting, surely the change of water has a greater effect on the tempering of steel. I claim that the welding and tempering of steel, and the working of iron, is as artistic as pouring pig iron into a hole, or executing a problem in "practical geometry" with all the angles, "curves and radii" required in making a pattern for a core print. The blacksmith has many difficulties to contend with—poor iron, bad coal, etc. J. P. W. states that he has studied the art of moulding. Did he ever study the work of the blacksmith? I don't refer to horse shoeing, nail or bolt making. I admit that there is a great deal both in moulding and pattern making, but that the blacksmith is inferior to either the moulder or pattern maker I deny. J. P. W. will have to adduce stronger arguments than the quotation from "Foundryman's" letter, and the four weeks' study of moulding, to convince me that the sons of Vulcan are in any way inferior to either moulders or pattern makers.

Waterbury, Conn. A. B.

Moulding Pulleys.

Editor American Machinist:

Having read several articles in the AMERICAN MACHINIST about moulding pulleys in green sand, I am prompted to give you a plan I adopted about ten years ago for sizes above 24″ diameter, which, I think, is a very economical and easy one. The patterns are very easily made. The rim and arms are separate, and the rim is made usually 6″ or 8″ wide, turned straight, and can be raised any width. I have made pulleys 40″ diameter and 24″ face, with an 8″ rim. I can put in the casting one or more sets of arms. The arm pattern is a half pattern without a hub, it having a small hole in the center, say ⅜″ (this is used as a dowel hole so as to use any sized hub). The moulding is very simple; the rim is set in the pit (generally bedded in the floor). The outside is rammed full, taking care not to spring the pattern, after which the arms are set the proper distance from the edge, according to the width of the pulley to be made. After it is set and the sand is nicely leveled, the arms are removed; first, however, marking with a pattern *A*, along each edge of arm the width of the dry sand core used in covering over. This is done to set the core by.



PLAN FOR MOULDING PULLEYS.

Then the center core, which forms half the hub, is set, the sand between the arms supporting it. This can be set by the mould below. Then the cores forming the remaining part of the arms are covered over the balance of the mould. The center core *B*, can be set in the mould first, or after the covering is set to its place. Pouring gates *C*, are made in the center core, the whole covered over with sand, and the pulley raised to the proper width. A cope is rammed on, the rim removed and the mould is complete. I have a man employed that moulded a 54″ pulley 16″ face with two sets of arms in half a day (without a helper). If this has ever been beaten I would like to hear of it. This plan of moulding makes a very clean mould, except a slight fin where the arm cores meet the center core. This can be dressed with a chisel so as not to be seen. I have made hundreds of pulleys by this plan, and don't remember that the moulder ever lost one. There is no patent on it, and if any brother foundryman sees fit to adopt the plan he is welcome to it.

Some moulders use wax for dressing on iron patterns. I use nothing but coal oil patterns for the pulleys are all iron.

GEO. E. STAUFFER.

East Stroudsburg, Pa.

Counterbalancing Engines—Core Prints—Hardening Steel Rolls—Master Workmen.

Editor American Machinist:

The rules laid down by Robt. D. Kinney for measuring irregular surfaces, and determining the centers of gravity of counter weights are very good, but these won't balance an engine. The first proposition, I think, is where the mistake is made. He says, "the weight of the crank-end half of the connecting rod is to be found." This would apply to a parallel rod, where the motion at each end is coincident; but it is evident that the combined movement of crank and cross head throws more than half the weight or connecting rod on the wrist pin, and makes difficult the method of finding the center of gravity of this weight, or determining the proper weight exactly to counteract the effect of different weights moving at different rates of speed.

Locomotive drivers afford an excellent opportunity for counterbalancing, and present a fair illustration of my plan as heretofore given. Here the counter weights are placed wholly outside of the wrist pin, and even at this radius the weight used is about equal to the combined weights of wrists, rods and boxes.

As for the cushion obtained by one-thirty-second, or even one-fourth of an inch lead, I think this would amount to but little practically in counteracting the momentum of the reciprocating parts.

Where round cores are more than twice their diameter in length, I think it best to taper upper end slightly egg-shape, so that a slight variation in length will insure a better fit at cope end. For job work, the lower or square end may be cut to suit the mould.

This, I think, is better than Olin Scott's "Sprue," and besides it is a little dangerous tamping around a core after the cope has been closed on. Crooked cores are a terror to the machinist, and to provide against them it is usual to allow twice as much for boring as is needed.

If the journals of the roll, shown in sketch by J. C. B., were turned slightly round in the corners, it would very much lessen the risk in tempering.

If heated only to a cherry red, and dipped vertically and quickly in tepid water, I think but few, if any, would break. If important to be perfectly true, these should be ground, after hardening, by an emery wheel connected with a slide rest.

I don't exactly like the position J. P. Workman gives the machinist, in comparing him with blacksmith, foundryman, patternmaker and draughtsman.

The expert original designer and draughtsman, not a mere copyist, I would place at the head of the list. But these are only the finishing touches to the thorough machinist; not that the moulder might not attain to the same mechanical eminence; but, as a rule, he does not, and so of the other branches. As a consequence, there are few men acting as general managers in manufactories of machinery, except thorough machinists. No doubt Mr. Workman will employ one to manage his ideal shop.

The art of drawing may be obtained during the term of apprenticeship, by devoting a few evenings each week to it, and if the young mechanic aspires to any degree of eminence in his line, he should do this by all means.

I have a higher opinion of the pattern-maker than even "Workman" has, and think he should not only be able to understand a drawing, but if necessary, be able to make one. As to the pay and respective values of these men, that I consider a very indefinite quantity, ranging all the way from $4 00 to $12.00 per day for men who class themselves in the first order.

QUIRK.

Chattanooga, Tenn.

Prevention of Boiler Explosions.

Editor American Machinist:

There exists the same necessity in every community for laws compelling steam users to submit to the inspection of their boilers by experts, as for laws punishing crime. Which is the greatest crime, the explosion of a boiler (often killing and maiming 20 to 30 heads of families—frequently their sole support) owned by a man whose common sense teaches him that his ignorance of the condition of the boiler is criminal, and who uses it year in and year out, uninspected, merely hoping that an accident won't occur, or the theft of a loaf of bread by a starving man? The law punishes the stealer of the bread and ignores the murderer of 20 men! There is no piece of machinery so universally used, the philosophy of which is so little understood, as the steam boiler. This want of knowledge has tended to create those mysterious explosions so frequently heard of, when an intelligent investigation would have revealed the causes. The so called experts have labored long and arduously to mystify the matter. It is frequently beyond their comprehension; their reputation is at stake, and it rests with them simply to evolve a theory beyond the comprehension of ordinary mortals, or to acknowledge their own incapacity to deal rationally with the subject. They are voluble with technical terms, and whether the disaster was due to the "repulsion," the "suspension," or the "spheroidal condition of the water," is argued *pro* and *con*, while the fact that a lot of stay bolts are gone, is not taken into consideration at all.

Such men make a bad matter worse, as they are like the dog in the manger, they cannot ascertain the cause themselves, and they frequently scare off, with the profundity of their condition, those whose common sense and practicability would shed the required light. A boiler, of all mechanical devices, should be built on the soundest principles. An engine may be defectively

designed and built, and still not be dangerous to life and limb. A boiler, on the contrary, will be certain to give out sooner or later, wherever the design or construction is faulty. Boiler builders and designers of boilers, are too frequently good workmen, but bad mathematicians. An uneducated man might work for years in a chemist's laboratory with safety to himself while under the directions of the chemist. If, however, he should conclude to experiment on his own hook, and should mix the contents of the first two chemicals he came across, the probabilities are, that if he had been a good man, he would soon be an angel. Yet the probabilities are no more so in his case, than that others would be who use a boiler designed by a man whose reputation was based on his ability merely, as a chipper, riveter, or caulker. A very great many boilers are designed by just such men. Faulty staying, too light iron in the flues, over-staying, marking sheets when chipping with the corner of the chisel, invite fracture. Blind rivet holes drifted into position, etc., etc., are but a few of the original causes, to say nothing about the evil practice of blowing boilers out when hot, that cannot afterward be entered and cleaned. Other causes are, the heat burning on the hard calcareous scale, or corroded stays eaten off, shirking their duty, thus overloading their neighbors. Safety valves are too frequently loaded down, instead of regrinding them, to prevent leakage. The operator thus burns his ships behind him by preventing the only source of safety from acting. This last ought to be a penitentiary offense, and would be, if I had the making of a few laws. I should say that about ninety-nine out of a hundred explosions could be prevented, by a proper system of inspection, enforced by law. Steam users should be compelled to be safe in spite of themselves; in fact, the law should take the same care of them as it does of other idiots.

Delaware, Ohio. Frank C. Smith.

Proper Mechanical Terms.

Editor American Machinist:

Mr. Olin Scott's communication in your issue of April 9th, 1881, headed "Mechanical Provincialisms," is a good beginning for arriving at some standard vocabularly in mechanics.

Take, for instance, that useful tool for all classes of mechanics, the adjustable or screw wrench, which is generally called "monkey wrench." *How absurd!* What connection has a monkey with the unscrewing of a nut from a bolt, or *vice versa?* Our friend Scott will recognize "monkey wrench," as it is said to have been *coined* "down East," perhaps in his State, Vermont.

Now "go West, young man," and hear what terms are used there. If you go aboard a steamboat the engineer will show you his "battery" of boilers. This, no doubt, in former years, was a very proper name for boilers of steamboats, if the death list from explosions on the Ohio and Mississippi Rivers is taken into consideration; if not, why a battery?

According to Worcester, "battery" means *beating.*

I hope that Mr. Scott will change his heading to that of "Proper Mechanical Terms," and then overhaul some of his Eastern friends, graduates of Yale, Cambridge, and other colleges, who use such profound and high-sounding terms as the following:

Actual energy,	All these terms mean simply work.
Work of energy,	
Stored energy,	
Kinetic energy,	
Potential energy,	
Intrinsic energy,	
Quantity of energy,	
Mechanical potential energy.	

The above terms only tend to confuse the pupil, and cause him to distrust giving his time to learning them, for fear he will not be able to master the subject, whereas, if he was assured that the simple term *work* will answer for all the different *energies*, he would feel more encouraged and devote more attention and time to his studies. To give some idea how these terms sound when applied in the place of the simple *force* or *work*, I quote from a lecture on "The Correlation of Vital and Physical Forces," delivered by a Professor in one of our universities, published by Van Nostrand, New York.

In this discussion he speaks of the ambiguity of language in regard to the word *force*, as follows:

"The word force, as commonly used, has three distinct meanings; in the first place, it is used to express the cause of motion, as when we speak of the force of gunpowder; it is also used to indicate motion itself, as when we refer to the force of a moving cannon ball; and, lastly, it is employed to express the effect of motion, as when we speak of the blow which the moving body gives. Because of this confusion, it has been found convenient to adopt Rankine's suggestion and to substitute the word energy therefor. And precisely as all force upon the earth's surface—using the term force in its widest sense—may be divided into attraction and motion, so all energy is divided into potential and actual energy, synonymous with those terms. It is the chemical attraction of the atoms, or their potential energy, which makes gunpowder so powerful; it is the attraction or potential energy of gravitation which gives the power to a raised weight. If now the impediments be removed, the power just now latent becomes active, attraction is converted into motion, potential into actual energy, and the desired effect is accomplished. The energy of gunpowder or of a raised weight is potential, is capable of acting; that of exploding gunpowder or of a falling weight is actual energy or motion. By applying a match to the gunpowder, by cutting the string which sustains the weight, we convert potential into actual energy. By potential energy, therefore, is meant attraction; and by actual energy, motion. It is in the latter sense that we shall use the word force in this lecture; and we shall speak of the forces of heat, light, electricity and mechanical motion, and of the attraction of gravitation, cohesion, chemism."

Is not the confusion in the above quotation enough to take a self-thinker's breath away? The professor confounds *force, motion* and *energy,* which are three distinct principles. Energy is the product of *force, motion* and *time,* and, consequently, *force* and *motion* are only elements of *energy.*

Now, Mr. Editor, how is it possible far students to learn anything from such a medley of nonsense as that in the above quotation?

One cannot take out from a book or lecture what is not in it, or in the language of a very learned scholar, "I never read more with less in it." If that lecturer on "The Correlation of Vital and Physical Forces" should be obliged to use proper terms, which would render the subject intelligible, he could not deliver the lecture without exposing his ignorance, but by using high-sounding terms and phrases as he did, probably not intending them to be understood, he made a favorable impression upon the credulous, which is the purpose for which such terms are often used.

In a late work on "Electricity and Magnetism," written by a member of the British Association, the mechanics of that subject is treated with a confusion of terms which renders the whole work obscure. On page 28, first volume, an article is headed "Electro-Statics and Electro-Kinetic," and below it is explained that when a flow of electricity is kept up by expenditure of work, it is called "Electro-Kinetic." If that savant of the British Association had studied mechanics, he would have known that that branch of electricity should have been called "Electro-Dynamics."

Chapter VI., on page 26, is headed "Potential;" and the explanation of the meaning of that term makes it fit equally well for *force, power,* and *work,* which are three distinct principles. The author, however, uses the term "potential" mostly for *force,* and on page 30 he proves by higher mathematics that "potential" is equal to *force;* whilst it is the very *force* itself, and nothing else, and should be called *force.*

Chapter V., page 25, treats of *density of electricity,* the substance of which is the same as that of "potential." The author says in the same chapter that, "When the density is not uniform, the surface density at any point is equal to the quantity of electricity which there would have been in the square centimeter surrounding the point of the density at every point, if that square centimeter had been the same as that at the given point."

The French electricians have established a unit of static *force* for electricity, which they call *dyne;* the value of which is 981.17 *dynes* per gramme. They have also established a *unit of work,* which they call *erg;* but they have no unit for *power,* which is a measure of the *current* of electric flow.

The science of "Electro-Dynamics" can never be complete without a unit for measurement of *power.*

The French do not use the metric weights for measuring *force* and *work* in electricity. Why would not a milligramme answer for unit of *force* in electricity? The true answer probably is that milligramme would not sound so scientific as *dyne* and *erg* do, but would only make the subject clearer. One milligramme is nearly equal to one *dyne.*

The work on "Electricity and Magnetism," above alluded to, contains a conglomeration of electric units, with singular terms, which only confuse the subject.

I would recommend that the "electricians" should study the simple terms in mechanics, for application in their science of electricity. W. Barnet Le Van.

3,607 Baring St., Phila.

Pulley Arms.

Editor American Machinist:

It seems as though some of the "boys" and myself were a little "uneven" on the question of even and uneven pulley arms. It was a question with me whether uneven arms would not remedy the evil to some extent; therefore, I wrote the letter to bring out some older or more experienced men than myself.

Mr. Thompson's view of the matter suits my notion very well, though I think in connection with the "relative massiveness" of rim and hub, it would be better to use uneven arms, as they are farther apart at the rim when there are a sufficient number to suit the size of pulley. For instance, I think instead of using 4, 6, 8, etc., use 3, 5, 7, etc., as I said in my first letter. Everything should be proportioned so as to avoid, as much as possible, the unequal shrinkage. Some pattern makers run to the extreme in making their pulley arms.

There is plenty of room for improvement in making pulley arms. Almost all manufacturers have their own notion about such matters. The result is that we have all sorts of ugly shapes, sorts and sizes for the same size pulleys, calculated to perform the same duty. If Mr. J. E. McComb and Mr. J. W. Thompson will tell us something about the "relative massiveness," together with the number of arms for each diameter of pulley calculated for ordinary duty, it will perhaps set me back on my base all right again. I know, of course, that the duty required of a pulley should be taken into account, but I think for ordinary purposes, there could be an approximate rule for the above. John B. Guinn.

Chattanooga, Tenn.

Hardening Steel Rolls.

Editor American Machinist:

Having wasted considerable time and money in getting up a pair of 4-inch steel rolls, I think I can give some information of value to J. C. B. His sketch (in issue of April 2), is a very fair representation of the rolls we now have in use.

1st. Ordinary cast steel will not do to make these large rolls of. It received a fair trial, and failed utterly. The two now in use were made of "German roll steel." There may be other steels which will do, but this I can vouch for.

2d. The rolls should be turned with large fillets in the corners of the journals, to avoid a sharp angle, and the liability of cracking.

3d. We covered the journals, when hardening the rolls, with a wrought iron shell, pinned on, so that the water should not come in immediate contact with the journals. This may not be absolutely necessary, but at any rate it did no harm.

4th. The roll so covered, was put in a large black lead crucible, and packed with bone charcoal, to completely cover it, and was then heated very slowly to a full red heat.

5th. A barrel of water, with about ten pounds of salt dissolved in it, was ready, at a temperature of about 40°. The roll was seized by one end with a pair of large tongs, and quickly suspended in the water, and moved slowly about until cool. One of the rolls which was not quite hot enough, required re-hardening, and this was accomplished without a crack.

6th. The rolls were then put in the lathe, and ground to size with a revolving emery wheel, fastened in the tool post. A little "crown" was necessary to compensate for springing, when in use. Journals and all were ground, to insure absolute truth.

The great secret of the whole matter is in the quality of the steel used. I am convinced that the ordinary tool steel is totally unfit for the purpose. The rolls we use are for copper, rolling it to an extreme thinness—between one and two thousandths of an inch. Buffalo.

Making Pulley Patterns.

Editor American Machinist:

I was thinking that a little personal experience of mine might be acceptable to those just starting shops, or about to do so.

Some years ago I had occasion to build a pulley pattern. We were just starting, and at that time had no clamps with which to hold the same. It occurred to me to use shoe pegs. I got the pegs and went to work. I split inch stuff, and started the circle with two rows of cants, putting pegs once in about two inches. The circle once started, jointed off one side, put in another row of cants with glue and pegs; faced off, and kept on until the rims were completed. Three or four hours sufficed for the work. I have made scores of them since. I let them dry for a day or two before turning up. They are not quite as smooth when turned up, but they keep their place and never come apart. For all practical purposes I prefer that plan.

Now a few words to the apprentices, that may have occasion to make a rim pattern for a pulley or wheel. Strike the circle for a pattern to cut out your stuff, and use the radius for the length of the cant, adding ¼ inch to the length after cutting out your stuff. Split to one-half thickness. Then start your circle, using six pieces to complete the circle. Use glue and pegs to fasten. The pegs should be ¾ to 1 inch long, and as small in diameter as you can get. You will be more than pleased with the result, for after trying this plan you will not go back to glue alone. Use a brad awl through the first thickness for your pegs.

To find the size of any wheel for any pitch, and any number of teeth, divide the pitch into 32nds of an inch. Multiply this number by the number of teeth, which will give the diameter of the pitch line in hundredths of an inch. Example: 1½ inch pitch equals $\frac{48}{32}$; this, multiplied by 35 (number of teeth) equals 1680 hundredths inches diameter of pitch circle. Again, $\frac{7}{8}$ pitch equals $\frac{28}{32}$; multiplied by 86 (number of teeth), equals 2408, or 24.08 inches. Multiplying the 32nds of an inch in the pitch by the number of teeth, will give the diameter of the pitch circle for any pitch, and for any number of teeth.

Pitch Line.

Glenwood, Iowa.

There have been thirty-eight fatal boiler explosions since January 1st, and the verdict has of course been "no one to blame." Boilers get mad and bust themselves.—*Detroit Free Press.*

Foreign Technical Notes.

Translated for the AMERICAN MACHINIST.

THE PARIS ELECTRICAL EXHIBITION.

The works for this exhibition, says the *Revue Industrielle*, have now begun. The internal arrangements will only be made at the Art Exhibition, which will take place from May to July. It is desirable, according to that journal, that the United States government appoint without delay an agent on behalf of the intended American exhibitors, who may be numerous, even in the light department.

INCREASING THE TENACITY OF IRON.

Le Charbon says that M. Leguin, of Paris, has patented a process for increasing the resisting power of iron goods to tension, bending, or torsion, by immersing them wholly or partly in hot diluted sulphuric or hydrochloric acids, or in a mixture of one part of turpentine in five or six parts of water. In the acid process, the metal is raised to cherry red heat, and then dipped in a solution of equal parts, by volume, of sulphuric acid of 66° strength, and of water. In the turpentine method, the mixture must be kept constantly stirred, lest the spirit should float upon the surface and take fire, on the introduction of the glowing metal. In either process, the metal is held in the solution till it has sunk to the temperature of the latter, and is then quickly thrown into cold water. The various implements, such as hooks, levers, beams, etc., subjected to this process, need only be partially immersed in the solution, the portions selected for treatment in each case being, of course, those which will necessarily be subjected to the greatest strain when in actual use.

NEW COMPRESSED AIR LOCOMOTIVES.

In the last number of the Swedish *Jernsköntoret*, it is stated that a new compressed air locomotive has been invented and patented by R. Akerman, of Motala, Sweden. It is said that it will run twelve miles without requiring replenishing, and draw three loaded tram cars at a speed which can be easily regulated. At an experimental trial, which took place at Stockholm a short time ago, the engine was started with a pressure of 900 lbs. to the inch in the reservoir, and when stopped in three-quarters of an hour's time, 600 lbs. pressure remained. The revolutions per minute were 112, and the total number of revolutions made was 4,960, which, if the engine had been running on a road, would have been equal to over eight miles traversed. This engine seems to outdo entirely the one invented by Col. Beaumont, with which, however, satisfactory results have also been obtained.

NEW TRAMWAY LOCOMOTIVES.

The *Maschinen-Constructeur* gives an elaborate description of a new locomotive for tramways, constructed according to Brown's system, and which are manufactured in Switzerland. Of the eighty so far constructed, and in different parts of the world in use, the best results as regards speed and saving of fuel have been obtained. The boiler of this engine is manufactured of Martin steel plates, and has a combination of horizontal and partly vertical cylinders. The engine itself rests on three points on the frame of the carriage below, which gives it a very quiet and sure position, even by a quick motion. It is a so-called beam-engine, according to the Belpaire's system.

THE HARDENING OF IRON AND STEEL.

The last number of the Russian *Technological Review*, published at St. Petersburg, contains some remarks by M. Chernoff, on the manufacture of steel, and the mode of working it. The author sets forth the great advantages of always hardening articles of ingot iron, and points out also how it is possible, merely by hardening, to remove the coarse crystalline texture, and the consequent brittleness, which distinguish iron, which has been long exposed to slight concussions. This alteration, as is well known, is specially prevalent in wagon axles, and it has accordingly given occasion to the precautionary measure that all wagon axles, even if they are to outward appearance ever so faultless, are rejected, or at least subjected to special examination, after running a certain number of miles. The advantage of getting these axles made again serviceable merely by hardening, is manifest. In his opinion, whether an iron, which from one cause or another has a tendency to burn, becomes, after a certain heating, burned or not, depends mainly on the degree to which it is afterwards drawn out; for the more an iron, which, when heated, has begun to be crystalline, is afterwards drawn out in a warm state, the less is the danger that the crystalline texture will remain in the fully-drawn iron. In this way it is explained why a greater degree of drawing out, and thus also larger ingots are requisite for a more than for a less phosphoriferous iron.

Newly Incorporated Companies.

PENNSYLVANIA.

The Brush Electric Light Company, Philadelphia; Henry Lewis, William Wood and others, incorporators; Capital, $200,000. For manufacturing, owning and operating apparatus used in producing light, heat, or power by means of electricity, with the right to acquire, hold, manufacture, and manage such property as may be deemed advisable in connection therewith.

The Gondolo Tannin Company, Philadelphia; William C. Banning, William H. Haines and others, incorporators; Capital, $150,000. For manufacturing and selling tannin.

The Chester Pipe and Tube Company, Chester, Delaware County; Henry Potts, Jr., Henry Mendinhall and others, incorporators; Capital, $300,000. For manufacturing iron or steel, or both, and any other metal, and any article of commerce from wood or metal, or both.

NEW JERSEY.

The Babcock & Wilcox Company, Elizabethport and New York; George H. Babcock, Stephen Wilcox, Edward Clark and others, incorporators; Capital stock, $225,000. To manufacture machinery by means of which steam is formed, used, or applied as a motive power, including steam boilers and their appurtenances, and the sale of the products manufactured.

The Bankers' and Merchants' Telegraph Company, office Jersey City; J. Heron Crosman, Garret S. Mott, and Jeremy G. Case, incorporators; Capital stock, $20,000. To build, construct, and maintain a telegraph line from the west side of Hudson River through Jersey City, Hoboken, and Weehawken, thence through the Counties of Bergen, Passaic, Essex, Union, Morris, Somerset, Hunterdon to the city of Lambertville, on the Delaware River.

The North Atlantic City Railway Company; Isaac A. Braddock, John S. Doughty, and Edward Z. Collings, incorporators; Capital, $50,000. To construct, maintain, and operate a railroad within the limits of Atlantic City, Atlantic County, New Jersey. The length of said road is 3½ miles.

The North Jersey Railroad Company; William O. McDowell, Edmund C. Stanton, Charles Minzesheimer and others, incorporators; Capital stock, $250,000. To construct, maintain, and operate a railroad from the Delaware River, near the mouth of Broadhead Creek, Warren County, to and through the Water Gap to Indian Bluff. The length of said road is about 2½ miles.

The Manufacturers' Railroad Company; Francis S. Lathrop, Anthony Reckless, John Kean and others, incorporators; Capital stock, $100,000. To construct, maintain, and operate a railroad from a point at or near the junction of the Newark & Elizabeth Branch of the Central R. R. Co. and the Newark & New York R. R., thence to the Passaic River, north of the Morris Canal, in the 12th Ward of the city of Newark. The length of said road is two miles.

The Railroad Safety Lock and Signal Company, Camden and Philadelphia; William C. Shaffer, Samuel M. Plush, Edward T. McKean, and George B. Dresher, incorporators; Capital stock, $1,000,000. To acquire by purchase, patent rights and interests in electrical and mechanical appliances, apparatus and machinery to prevent collisions of railroad trains by misplaced switches, broken rails, etc., etc., and to manufacture, use, sell, and deal in the same, and to sell, lease, or otherwise dispose of said patents or rights.

The Atlantic City Iron Pier Association, Atlantic City, Camden, Philadelphia, and New York City; William R. Sanders, D. Davis Rogers, and R. Taylor Middleton, incorporators; Capital stock, $250,000. To construct, maintain, and manage an iron pier, or piers, in Atlantic City, and building and operating bath houses and pavilions connected therewith, and to operate a line of coastwise steamers.

NEW YORK.

The Automatic Can Machine Company, New York; Chas. E. Butters, Wm. N. Conner, B. F. Mesereoy, R. H. Wadleigh, Nathan H. Daniels, Henry Lunt and Thomas S. Williams, incorporators; Capital $300,000. To manufacture tin cans and machines for making the same.

The Universal Stamp and Punch Company, New York; Elias B. Brown, Albert A. Rice and John T. Mills, incorporators; Capital $500,000. To manufacture and sell stamps and punches for railroads, banks and other business purposes.

The American Boot, Shoe and Last Company, New York; Asa Johnson, Geo. W. Garretson, Wm. W. Gibbs, Emmet R. Olcott and I. T. McClintock, incorporators; Capital $500,000. To manufacture boots, shoes and lasts of every description, and the necessary apparatus for the manufacture of the same.

The Wahsatch Coal and Iron Company, New York; Benj. G. Smith, Jr., Chas. H. Smith, Jr., Edward H. Guernsey, incorporators; Capital, $1,000,000. To operate mines of coal, iron and other metals, and to build, equip, and operate mills, furnaces, smelting and reduction works in Territories of Utah, Wyoming, Idaho and Montana, and States of Nevada and Colorado and elsewhere.

Novelty Casket Trimming Company, Rochester; Albert H. Nirdlinger, A. Voght, and Leopold Stein, incorporators; Capital, $10,000. To manufacture and sell casket trimmings.

Buffalo Electric Light Company, Buffalo, N. Y.; John F. Moulton, Alfred P. Wright, Jas. R. Smith and others, incorporators; Capital, $100,000. To establish and carry out in the city of Buffalo the business of lighting streets, avenues, parks, places and buildings by electricity, and to manufacture, sell and lease all machines and apparatus necessary therefor.

Port Dickinson and Chenango Railroad Company; Geo. Q. Moore, Walter J. Moore, Robt. J. Bates and Granger Comstock, Binghamton; Geo. W. Stow, Jno. W. Gulnack, Edward S. Stow, Henry E. Merrill, E. E. Lamaraux, Nelson Stow, Jos. Carman, Silas N. Carman and Jacob Schuepper, Port Dickinson, incorporators; Capital, $10,000. To construct, maintain and operate a railroad, commencing at the Syracuse, Binghamton and New York Railroad, at the Phelps farm in town of Binghamton and terminating at the Chenango River. Length of road, about half a mile.

Maritime Manufacturing Company, New York; Earle H. Smith, Wm. H. McDougall and Charles H. Fuller, incorporators; Capital, $500,000, and may be increased to $5,000,000. To manufacture sails for ships and vessels, and sewing machines adapted to making sails for ships.

OHIO.

The Cleveland Lock Company, Cleveland; J. H. Teller, L. Austin, and others, incorporators; Capital stock, $30,000. For the purpose of making and selling machinists' tools, locks, and other shelf hardware, and other articles in the line of machine work.

The Wapakoneta Automatic Car-Coupling Company, Wapakoneta; Lyman N. Means, August Smith, and others, incorporators; Capital stock, $6,000. Purpose, manufacturing a patent car coupling, selling rights, etc.

The Cincinnatti, Van Wert and Michigan Common Carrier Company, Van Wert; E. C. Dawes, S. N. Maxwell, C. H. Bosworth, and others, incorporators; Capital stock, $50,000. To construct, complete, equip, lease, hold and operate the Cincinnati, Van Wert and Michigan Railroad.

The Freeman Fire Clay Company, Freeman's Station, Jefferson County; John M. Freeman, John Moren, and others, incorporators; Capital stock, $80,000. To mine fire and other clays, and manufacture fire brick, sewer pipe, terra-cotta goods, and all other products of fire clay.

The Piney Fork and Connotton Coal, Coke, Mineral, Mining, Manufacturing and Railway Company, Hopedale; A. B. Paul, Theo. Leggett, and others, incorporators; Capital stock, $100,000. For leasing ore lands, mining coal, ores, and manufacturing coke, iron, and glass.

The Cleveland, Youngstown and Pittsburgh Railway Company, Cleveland, O.; Wm. A. Lynch, Theodore E. Burton, Geo. L. Doke, John M. Henderson, and Homer B. DeWolf, incorporators; Capital stock, $1,000,000. To build a railroad from Cleveland to Ohio and Pennsylvania State line, and to pass through the counties of Cuyahoga, Summit, Portage, Trumbull, and Mahoning. Eastern terminus not definitely fixed.

The Nelsonville Foundry and Machine Company, Nelsonville; Thos. E. Knauss, Charles A. Cable, and others, incorporators; Capital stock, $30,000. To manufacture cars, castings, and machinery.

The Springfield Casket Company, Springfield; Jos. S. Boyle, T. A. Wick, and others, incorporators; Capital stock, $100,000. To engage in business of making burial caskets and coffins, and undertaker's hardware.

The Cleveland Specialty Foundry Company, Cleveland; H. L. Milton, W. W. Baldwin, James M. Bates, and others, incorporators; Capital stock, $50,000; shares, $10 each. To manufacture metal castings, and do a general foundry business.

CONNECTICUT.

The New Hat Co., Danbury; H. T. Moore and others, incorporators. Capital, $1200. To manufacture hats.

The Barton Bell Co., Middletown; O. L. Clark, A. W. Barton and A. L. Barton, incorporators. To manufacture bells of all kinds.

MASSACHUSETTS.

The Harwood & Quincy Machine Co., Worcester; George S. Harwood, Prest., Geo. H. Quincy, Treas. Capital, $20,000. For the manufacture and sale of machinery for making textile fabrics and other machinery.

INDIANA.

Electric Light and Gas Heating and Illuminating Company, Laporte, Laporte County; Capital stock, $50,000; principal incorporators, Eugene W. Davis, Hatch Mills, James Murdock and Wm. D. Hutchinson.

Electric Lighting and Gas Heating and Illuminating Company, Michigan City; Capital, $50,000; principal incorporators, James Murdock, Wm. B. Hutchinson and Thomas Hanlon.

Electric Lighting and Gas Heating and Illuminating Company, South Bend; Capital, $50,000; Principal incorporators, David R. Leeper, James Murdock and Wm. B. Hutchinson.

Eel River Woolen Mill Co., Columbia City, Whiteley Co.; Principal Incorporators, Christian D. Waidlick, Thomas Washburne and Martin Ireland; Capital stock, $10,000. To manufacture woolen goods.

Electric Lighting, Gas Heating and Illuminating Company, of Logansport; Capital, $50,000; Principal Incorporators, N. O. Ross, C. B. Knowlton, R. Huthins, and others.

ILLINOIS.

The Twin City Gas Works, La Salle; Michael Byrne, Jas. W. Duncan and others, incorporators; Capital, $60,000. To manufacture gas, coke and tar.

Central Telephone Company, Chicago; Wm. G. Beale, N. F. Hanson and others, incorporators; Capital, $250,000. To manufacture telephones and all apparatus connected therewith.

Bellville and St. Louis Railway Co., James A. Waterworth, Wm. S. Bradley and others, incorporators; Capital, $1,000,000. To construct a railroad from Bellville, in St. Clair Co., to Venice, in Madison Co., with a branch from a point on said line in St. Clair Co. to East Carondelet, in said County. Principal office, East St. Louis.

Success of a Two-Foot Gauge Railroad.

Some time ago we published a few notes upon the narrow gauge (two-foot) railroad running from Farmington to Phillips, Me., a distance of 18 miles. The superintendent, Joel Wilbur, has issued an annual report giving the following table of receipts and expenditures during its first 13 months and 10 days (from its opening, Nov. 20, 1879 to the 1st of January, 1881):

Earnings from passengers	$7,575.42
" " freight	4,987.67
" " express	279.08
" " mail	743.96
Gross earnings	$13,586.13
Deduct for operating expenses	11,672.40
Net earnings	$ 1,913.73
Deduct for interest on bonded debt and temporary loan	1,526.20
Surplus credit	$ 387.53

The operating expenses were as follows:

Fuel consumed	$ 1,443.21
Maintenance of way	4,556.78
Train expenses	3,147.34
Station expenses	1,684.96
Salaries	840.11
Total expenses	$11,672.40

The item of expense for maintenance of way in latter table seems to be the larger, owing to the very faulty construction of the road by its contractors, causing the necessity for constant repairs, an item that will probably be reduced in amount after the road-bed gets once thoroughly graded and the trestles get settled to their proper foundation. Thus it will be seen that this road has more than paid its expenses, together with the interest on debt for the first year of its running, a showing that probably no other road has ever made in the State of Maine.

These two-foot gauge roads seem to be well adapted to developing the industries of sections of the country not very far remote from regular lines of railway, where it would cost too much to build and equip a standard gauge road as a feeder. Two others are projected in the State of Maine; one from Skowhegan to Athens, and another from Farmington to some point on the Kennebec near Augusta. The latter is to be 35 miles long.

The locomotives for the two-foot gauge railroad now running are proportioned as follows: diameter of cylinders, 8″; stroke, 12″; diameter of driving wheels, 30″; total wheel base, 13 ft.; driving wheel base, 3½ ft.; weight of engine and tender full of fuel and water, 23,750 lbs.; weight on driving wheels, 14,350 lbs.; capacity of tank, 400 gallons; diameter of boiler shell, 30″; diameter of dome, 18″; length of inside fire-box, 30″; width 27¾″; height, 37″; water-space, 2½″; number of tubes, 70; diameter, 1¾″; length, 6 ft. 7″; thickness of boiler shell, 5/16″; thickness of steel plates for fire box, ¼″; steel tube sheet, ⅜″; size of steam ports 6″ x ¾″; size of exhaust ports, 6″ x 1¾″; steel driving wheel tires 2″ thick by 5″ wide (one pair without flanges); size of journals, 4″ x 4″; diameter of chilled cast-iron truck wheels, 18″; truck axles outside bearings, 5″ x 2⅝″ diameter. The capacity of an engine on a level is to draw 300 tons. These engines through the manner of their construction, having their weight near the track, ride as smoothly and as steadily as the best broad gauge engines.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Prest.

JACKSON BAILEY, Vice-Prest.

LYCURGUS B. MOORE, Treas. and Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

LEWIS F. LYNE, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.

The International News Company,
(Formerly the Wilmer & Rogers News Co.)
11 BOUVERIE STREET, (Fleet St.) LONDON, ENG.
Will receive subscriptions for the AMERICAN MACHINIST at 17 shillings per annum, postage prepaid.

DEALERS SUPPLIED BY
The New York News Company, New York.
The National News Company, New York.
The New England News Company, Boston, Mass.
The Central News Company, Philadelphia, Pa.
The Western News Company, Chicago, Ill.
The St. Louis Book and News Co., St. Louis, Mo.
The Cincinnati News Company, Cincinnati, Ohio.
The Detroit News Company, Detroit, Mich.
The Pittsburgh Book and News Co., Pittsburgh, Pa.
The Baltimore News Company, Baltimore, Md.
The Rhode Island News Co., Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The Brooklyn News Company, Brooklyn, L. I.
The Newark News Company, Newark, N. J.
The Northern News Company, Troy, N. Y.
The Albany News Company, Albany, N. Y.
The Washington News Co., Washington, D. C.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton Branch, Clifton, Ontario, Canada.

SUBSCRIPTION.

$3.00 a year, in advance, postage prepaid in the United States and Canada.
$4.00 to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 30c. per line, (12 lines one inch.)
"Business Specials," 50c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, APRIL 23, 1881.

CONTENTS.

PAGE.
New Method of Driving the Hudson River Tunnel. 1
Success of a Two-Foot Gauge Railroad..... 2
Extracts from Chordal's Letters..... 3
Draughtman's Bevel. By John W. Nystrom..... 3
New Valve Gear..... 4
Theory and Practice. By F. F. Hemenway..... 4
Letters From Practical Men.—Taking Care Steam Boilers.—Position of the Blacksmith.—Moulding Pulleys.—Counterbalancing Engines—Core Prints—Hardening Steel Rolls—Master Workmen.—Prevention of Boiler Explosions.....4, 5, 6
Newly Incorporated Companies..... 7
Foreign Technical Notes..... 7
Promotion of Local Manufactures..... 8
New Machine Shop at the Stevens Institute..... 8
Cost of the Electric Light..... 8
Rewarding an English Inventor..... 8
New England Industrial Exhibition..... 8
Questions and Answers..... 9
Manufactures..... 9
Machinists' and Engineers' Supplies.....10
Iron and Metal Review.....10

The printed date on each wrapper shows the time to which the subscription is paid. We discontinue the paper in all cases when the time paid for has expired, unless renewed.

Promotion of Local Manufactures.

The present wonderful activity in extending our manufacturing industries, by the starting up of new establishments, has prompted the citizens of many towns and villages to offer extra inducements to new shops, mills and factories to locate within their limits. To secure one or more industrial establishments, employing even a few hands, is a valuable acquisition to a small town, as the money paid out for wages goes into circulation at home, and thereby aids every local business enterprise. It is therefore an important consideration for the citizens of towns needing manufactories, as to what inducements they can prudently offer to attract the projectors of such enterprises. The natural advantages of an unfailing water power, at low cost, is well worth considering, but, while highly economical and reliable steam engines are readily obtainable, it ought not to be the only inducement for pitching upon any particular site. The cost of power in well-regulated concerns bears but a small ratio to the value of the work accomplished, though power is an element upon which large sums of money are annually wasted. Every projector of an industrial works is, or ought to be, determined to economize as far as possible in its management. Some towns offer not only free water power but free sites, and, in some cases, the brick necessary to construct shops, or a bonus in money. Expenditures in this direction are usually productive of satisfactory results to the business interests of the towns.

In many cases new manufacturing establishments are promised exemption from taxation for five or ten years. This course is open to some serious objections. At least one or two courts have decided that such agreements are unconstitutional, and it is questionable whether those entered into in other States will be allowed to stand until the expiration of the periods specified. Manufacturing establishments that started without any such guarantees are placed at a disadvantage, as, by reason of many exemptions, they are obliged to pay more than their proper share of tax. A much better plan to attract productive industries to a town is for the business men to unite in subscriptions to purchase and present a site, or to erect buildings, or to purchase stock if an incorporated company is to be formed. This course is not open to any of the objections adhering to government exemptions, and will commend itself to all classes of enterprising tradesmen in a town wanting manufactures.

New Machine Shop at the Stevens Institute.

For several years past a part of the basement of the Stevens Institute, Hoboken, N. J., has been used as a workshop and foundry. The absorbing interest on the part of the students in practical and applied mechanics has increased, year by year, to such an extent that the greater part of the basement was finally occupied and found too small for the accommodation of the students. In the rear of the building is a large hall, about 50x80 feet, which was first used as a lecture room, then as a gymnasium, though very little used for either of the above purposes. One of the most notable events that occurred in connection with this hall was the organization of the American Society of Mechanical Engineers which took place there April 7, 1880, soon after which it was decided, through the munificence of Prof. Henry Morton, president of the Institute, to convert the hall into a workshop. Work was accordingly begun, and an open gallery was put up, leaving a space above the main floor of 14 feet. The opening being in the center, leaves a gallery on each side of 15 feet deep. At the end of the hall is a large room, used as a dressing and wash room, provided with hot and cold water; also, a shower bath. The power to drive the shop is furnished by a Buckeye engine of 20 H. P., which is filled with appliances for the application of indicators, and for making tests. The shop is well stocked with lathes, planers, drill presses, and a milling machine, no two of which are from the same manufacturer. There are a number of small lathes for turning wood, which were made by the students in the Institute. The vice benches extend along the wall upon either side. The wood-working benches being upon the east side, are provided with a closet to each vise, and are stocked with a full set of carpenters' tools. The bench for iron working is upon the west side, and is well designed for its purpose, each student having a drawer or locker in which to keep his tools. The tool room is located in the gallery, which is reached by a winding iron staircase.

The check system is used in giving out tools, and, in fact, a shop system is practically carried out, the work being in charge of a foreman and a first-class workman as instructors.

It is not intended to manufacture anything of any commercial value, as such a course would seriously interfere with the advancement of the student. The course adopted is to draw a design representing a block of wood or metal, which will have the most regular and irregular shapes upon it, so that the student, upon receiving the drawing and material, will, in executing his work, get more experience than upon manufactured articles found in the market. This is accomplished with the waste of but little material.

After the problems have been executed, the work and drawing is deposited at the tool room window for inspection, after which the necessary criticisms are made and the material thrown into the scrap heap. By adopting such a course, the student is advanced as rapidly as he wishes to go. To obtain material, each student is given an order book in which he writes out his orders and delivers the same to the store keeper who furnishes the material, charging the same. Thus a correct account is kept of the material used. A very convenient form of tool gauge is placed on a pedestal at each grindstone, by means of which the student is enabled to grind the cutting edges of his tools to the proper angles.

There are accommodations in the shop for about 30 students, all of whom are under the direct supervision of J. E. Denton, Instructor in Applied Mechanics and Shop Practice.

Mr. Denton has a small apartment at one corner of the room in which he prepares problems for the students.

A cupola has been erected in the basement which enables the students to try their hand at iron moulding, and to experiment in other metallurgical operations. The management of the Institute is endeavoring to offer every facility for the rapid advancements of students, in obtaining a thorough technical and practical education.

Cost of the Electric Light.

One of the striking features connected with existing electric-lighting systems is the lack of information, which the public possess, regarding the cost of producing the electric light. The public are asked to buy stock in, and grant franchises of the utmost value to electric-lighting companies, upon the strength of loose statements as to cost, which bear about the same relation to real information, that "a piece of chalk" does to measurement. In every other mechanical device we have positive data placed before us, as an inducement to make serious investments. The town or city which wants a water-works pumping engine is put in possession of all the facts relating to the performances in various tests, of every engine which claims any sort of standing. In steam engines and water wheels, the same can be said. In electric lighting alone, the public are asked to buy an unknown quantity.

It may be that the electric light will "cost more than gas," and be freely adopted in preference to gas, because it is worth more. If so, why not let the public know just what it is asked to pay for? If it is to be "cheaper than gas," as has been so confidently claimed, why are opportunities to cipher out the cost of producing the electric light under good, bad, or indifferent conditions, so industriously and persistently staved off? Why are not disinterested engineers, with reputations to lose, put in position to tell us how many pounds of coal are required to work up ten or twenty or one hundred lights of some definite capacity that can be compared? If a "private" test is made, why is publication industriously suppressed?

A distinguished worker in this field once said to the writer that he could "give his light away," and still pay dividends to his stockholders through the sale of power. However this anticipated demand for light power may prove, in small manufacturing establishments, and in business buildings and residences for running elevators, pumping water, etc., one fact should not be overlooked: No such establishment will ever be content to use electric power only in the day time, and electric light only at night. Both light and power must be made available for day use at pleasure, and it is obvious that any system of providing electric light and power, which does not also provide facilities for their free use and interchange, is likely in practice to fall far short of the views of its projectors.

Rewarding an English Inventor.

On Friday evening, April 1st, a complimentary dinner (at which the AMERICAN MACHINIST had the pleasure of being represented) was given at Delmonico's, in this city, to Sydney Gilchrist Thomas, the distinguished English chemist and engineer, now visiting this country, by about fifty gentlemen, prominently connected with the various departments of our iron industries. Hon. Abram S. Hewitt presided, and speeches were made by the chairman, the guest of the evening, Prof. Chandler, Prof. Thurston, A. L. Holley, Ex-Mayor Cooper, and others. The compliment of the dinner was emphasized by the conclusion of an agreement, reached only the day previous, by which the Bessemer Steel Association of this country agree to pay Mr. Thomas $275,000 for the American patent relating to his process for "dephosphorizing" pig iron. In this country a large proportion of the pig iron can only be made available for the manufacture of Bessemer steel by eliminating the phosphorus which it contains, hence, liberal as the sum above named may seem as the price paid to one man for a sheet of paper, its ultimate value to the industries of this country may exceed even the wildest conjecture. It is safe to assume that thousands who never heard the name of Sydney Gilchrist Thomas will enjoy incomes and home comforts as the result of his work.

One of the pleasant points of the evening was brought out by the statement of James C. Bayles, that the original paper detailing the discovery of the dephosphorizing process, which the Iron and Steel Institute of Great Britain declined to hear, was a few months later published by him in full in the *Iron Age*, and thus brought to public notice in this country months in advance of English recognition of its value.

The youth of the inventor of the dephosphorization process (he being only thirty), and the modesty with which he claimed for others before him a share in the credit, may well suggest the reflection that few persons realize how many great industrial and business enterprises are now being conducted by young men, and the cause is not far to seek. The same conditions now prevail in mechanics, which have in all ages made success in art, literature, and music possible to young and old alike. In those branches the success of any student depends, not greatly upon knowing what others have done in past ages, but mainly upon native talent and individual skill. In mechanics, every advance is based directly upon or made possible by some previous advance; and now, for the first time since the world began, young and old work to-

gether in mechanics upon an equal footing The scientific and mechanical literature of this age crystallizes the theory of yesterday into the practice of to-day and the improvements of to-morrow. The young man of to-day knows what others have done, in what they succeeded, and where and why they failed, and is thus in position to begin where they left off, thinking with their thoughts and working with their tools.

New England Industrial Exhibition.

The New England Manufacturers and Mechanics' Institute is making rapid progress in the construction of its building in Boston. The four walls are erected, about fifty feet of the girders are built, and the roof is rapidly going up. At a meeting held March 31, the city government appropriated sixty thousand dollars to extend Huntington avenue, on which the building is located, passing the front of the building to the main entrance of the new park. This avenue will be one hundred feet wide and will be an ample thoroughfare to the exhibition building.

The exhibition this Fall promises to be a great success. The leading manufacturers of New England are taking an extraordinary degree of interest in it, and are vieing with each other to see who shall make the best exhibit. Over 700 applications are now handed in. One exhibit, it is said, will cost for the mere cost of putting it in and taking it out of the building, over $30,000. The exhibition of shoe machinery in motion will comprehend 129 different machines, arranged as in a shoe factory, by which shoes will be manufactured on the spot. At one end of the line sides of leather are to be fed in, and at the other the manufactured and marketable boot or shoe taken away. This exhibit, we are informed, has been attempted at other Exhibitions but has never been fulfilled. Arrangements have, however, been concluded, and the makers of the various machines needed are pledged to its successful accomplishments. This exhibit is under the control and at the suggestion of a gentleman who is one of the commissioners to the World's Fair, and one of the Institute's Executive Committee. He was also one of the United States Commissioners to the Paris Exhibition, and the Massachusetts Commissioner to the Centennial.

Applications for space or for particular information should be addressed to the New England Manufacturers and Mechanics Institute, 5 Pemberton Square, Boston, Mass.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) J. T., Catasauqua, Pa., writes: 1. I am informed that in New Orleans they are using compressed air as a propelling power for street cars. Can you tell by what means they raise a pressure sufficient for the purpose, and how great that pressure is? *A.*—A special air compressor at a central station is used, which maintains a pressure of about 350 pounds per square inch. 2. Is it necessary on the cars using the compressed air (which I understand is obtained from a main reservoir) to keep the cylinder *reheated* to prevent freezing of the moisture by expansion? If so how is it accomplished? *A.*—The compressed air after leaving the tank in which it is stored in the car, is passed through a heater containing hot water, where it picks up enough heat to prevent the temperature from falling very low when it is expanded in the engine cylinder. 3. Is it necessary in the main apparatus to cool the compressing cylinder? *A.*—Yes. This is generally done by either a water jacket about the air cylinder, or by circulating water within the same.

(2) L. B., Chicago, Ill., writes: I have a main line shaft running at a speed of 150 revolutions per minute. About 5 horse power is now transmitted from a pulley near the main belt. How much more power will it take, if any, to drive the same machinery if the transmission from the main shaft be made 50 feet distant from the main belt. *A.*—If the shaft is, say 2″ in diameter, well supported and lined up, the difference in driving power, whether you take off the 5 H.P. near to or 50 feet away from the main belt would be inappreciable. If, however, it is a 1½″ shaft, not well lined-up and supported, the torsional action, or twisting, buckling and springing of the 50 feet line, would effect a loss of power, in friction, conflicting motions and forces. These could only be estimated by knowing all the dimensions and conditions of the line shafting.

(3) R. W. K., Detroit, Mich., writes: Why do engineers and builders of engines differ so greatly in regard to the proportion of an air pump? Roper says 1-15 of the cylinder capacity, Haswell about 1-9, Chas. W. Copeland 1-9, Bourne from ¼ to ⅛. Who is right? *A.*—The difference in opinion and practice of engineers, in this and other matters of engineering and mechanics, most commonly is due to there being no well-established rule and practice by which they can be guided; and they must, therefore act and judge by their own observations and reasons. In matters in which engineers disagree, the one embracing the best practical experience is safest to follow. Chas. W. Copeland is one of the oldest if not *the* oldest professional mechanical engineer in this country. He is known as a thorough practical man, and is considered excellent authority on the subject you refer to.

(4) A. S. P., Paterson, N. J., asks: Will you kindly tell me what to use to give a blue color to steel and iron that are polished? I have seen some models that have been most beautifully colored and I would like to know the way it is done. *A.*—The process for bluing steel was described in the AMERICAN MACHINIST, of May 8, 1880, and consists in polishing the articles to be blued and subjecting them to a uniform heat sufficient to produce the color desired. The heat may be imparted to the articles by a sand bath, wood ashes, or a flame producing no soot or deposit.

(5) H. M., New York City, writes: Can a person who claims a patent for an invention for parting hair by air-blast with a common bellows, prevent me from using or patenting my invention, in which I employ compressed air with another kind of bellows, or apparatus for making the air-blast? *A.*—The party who first invented and made an apparatus to part hair with an air-blast from compressed air of a bellows, especially arranged and adapted for that purpose, could take out a patent with claims broad enough to cover that new application of mechanism for that purpose, so as to make any modified form of the air-blower subordinate to his claim. But you can claim and patent, and he cannot use without infringing on you, any new kind of air-blower, of different mechanical combination for the same purpose as his, if it be of your invention. But you could not use it without infringing on his invention; provided, as we said, he was the first to invent and use a machine of that kind for that purpose, and that he has a patent covering it that has not expired.

(6) P. F., Chicago, Ill., writes: I would be thankful for an answer to the following questions: (1) Do you think an earnest person, of twenty years of age, ought to serve three years in a factory machine-shop where they have only one planer and three lathes, with wages that barely support him? *A.*—A young man, of that age, in earnest to learn the machinist's trade, should go into a shop well equipped with good tools and skillful workmen, so as to have a good opportunity to acquire the art of working in metals. But it often is the case now, in large establishments, that "piece work" is the system of labor, so that a learner cannot have the variety of practice, necessary to a good training in the trade; while in smaller shops he can have a greater variety of work and use of machine tools, so that, generally, the small and well-equipped shops are the best to learn in. The question of wages is one settled by the customary prices paid for the work done. (2) What do mathematics consist of and what is their use? *A.*—Mathematics is the science of quantity. It embraces Arithmetic, Geometry (including Trigonometry and Conic Sections), Analysis in which letters are used as in Algebra, Analytical Geometry and Calculus. (3) Can a person be an improver of machinery or process without being an inventor? *A.*—Any improvement in the combining together, or forming, of materials or matter, is an act of invention, whether it be a wholly new conception or but slightly different from that which has been done before, and a person is the inventor, just so far as his own improvement extends and no farther.

(7) B. T., Philadelphia, Pa., asks: (1) Can I get a coil spring made with the capacity to lift 2000 pounds 3 ft. high in two or three minutes; and do you know of any spring manufacturer that can make such a spring? *A.*—A coil spring of that power could be made, but with such cost and difficulty, and liability to break in using it, as to make it, we think, impracticable. We do not know of any one making such heavy coil springs for motive power. (2) Is there any device for feeding hot water to locomotive boilers without stopping on the track? *A.*—Most locomotive boilers are fed with water from the tender, by an injector, worked by steam from the boiler, and the feed water is heated in passing through the injector into the boiler. This plan has worked so satisfactorily that pumps are rapidly going out of use and two injectors are applied to each locomotive. (3) Is there any other device than the scoop and trough, for feeding water to a locomotive, without stopping the engine? *A.*—We do not know of any other successful appliance in use.

(8) X. Y. Z., New York City, asks: Are there any "Free Schools" in this city for teaching Mechanical drawing, or what would a course of lessons cost me in that branch? I am a fireman on the Elevated Road, and have some spare time and I think I could not put it to better use. *A.*—There is a free night school at the Cooper Institute which includes a course in drawing. The only expense to the student is the cost of materials and instruments used. By applying at the office of the Institute you may readily obtain all necessary particulars.

BUSINESS SPECIALS.

50 cts. a line for each insertion under this head.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

"Patent Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton St., New York.

Alfred Wilkinson, Expert Engineer, S. W. Corner Second and Girard Avenue and 1114 Beach St. P. O. address, Manayunk, Phila., Pa. Indications of Steam Engines a specialty.

Tube Cleaners from 2″ to 4″ $1.00 each. American Tool Co., Cleveland, O.

"Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. $1.50 by mail, postpaid. American Machinist Publishing Co., 96 Fulton Street, New York.

1-16 to ⅛ Steel Figures $1.00 per set, Letters $3.00 per set. American Tool Co., Cleveland, O.

Vertical and Horizontal Pumps. Capacity from 100 to 35,000 galls. per minute. Simple, Efficient, Economical, Durable. Used by more than half the tanners and paper makers of the country. Horizontal and Vertical ENGINES, from 10 to 30 H. P., for long continued hard work. Prices, 40 per cent. below other makers. Send for circulars. Heald & Morris, formerly Heald, Sisco & Co., Baldwinsville, N. Y.

James W. See, Designing and Consulting Engineer, Hamilton, Ohio.

J. C. Hoadley, Engineer and Expert, formerly of Lawrence, Mass., has opened an office at 29 High St., cor. Federal, Boston, Mass., where he will be pleased to receive old and new friends.

Steam Engines Indicated and Examined. Power Measured. W. H. Odell, P. O. Box 274, Yonkers, N.Y.

Bound volumes for 1880 of the AMERICAN MACHINIST.—We can furnish Vol. 3 of the AMERICAN MACHINIST, containing the full 52 issues of 1880, neatly bound in cloth, ready to ship by express, for four dollars. AMERICAN MACHINIST PUBLISHING CO. 96 Fulton Street, New York.

Wood Engravings of Machinery and Tools. Satisfaction guaranteed. Chas. Murray, 58 Ann St., N.Y.

Wanted to arrange with responsible parties for the manufacture of a New Air Compressor. The best yet designed. John Fish, 8 Pine Street, New York.

MANUFACTURES.

The Elyria Shear Works are to be removed to Youngstown, O.

The Heaton Emery Works Company, at Ballston Spa, N. Y., contemplate removal to Albany.

The thirty-two lumber mills of Muskegon, Mich., are expected to cut 775,000,000 feet of lumber this season.

Derby Bit Co., Derby, Conn., have bought an old sawmill site on Beaver Brook for manufacturing purposes.

The Culmer Spring Co., of Pittsburgh, Pa., have sold their works to the French Spiral Spring Co., of that city.

Narragansett Mfg. Co., Fall River, Mass., are building a brick machine shop 30 x 78 feet, two stories high.

The Hancock Inspirator Co., Boston, Mass., are running with a force of 100 men, and are crowded with orders.

Emerson, Smith & Co. are enlarging their saw works at Beaver Falls, Pa., and will put in a 150 H. P. engine.

The Elgin (Ill.) Watch Co. are building an addition to their works with a view to making 1,000 watches a day.

H. C. Goodrich is building a three-story factory for sewing machine attachments in Chicago, at 68 and 70 Ogden Place.

The Cuyahoga Works, Cleveland, O., are building eight engines for the North Chicago Steel Works. They employ 150 men.

The Monarch and Eclipse Machine Co. has been organized at Hamilton, O. They have purchased the Owens Lane & Dyer Machine Works.

Lincoln Mfg. Co., Chester, Pa., are about to build a new mill for the manufacture of hosiery yarn. Wm. Blakeley is treasurer and manager.

The Pittsburgh Bessemer Steel Company, limited, started their new works at Homestead, Pa., on March 19th, when they made their first ingot.

J. H. McGowan & Co., steam pump manufacturers, Cincinnati, O., have just completed and moved into their new shop, which occupies half a square.

Mr. Kimball, Pres. of the Chicago & West Michigan R. R., is at the head of a new concern now building car shops in Muskegon, Mich., to employ 300 mechanics.

The Peace Dale, R. I., Manufacturing Company, established on the co-operative plan, has declared a dividend of 5 per cent., the total amount to be distributed being $6,000.

Herreshoff Mfg. Co., Bristol, R. I., are adding a new machine shop to their works, 65 x 30 feet, two stories high, and will enlarge their force of men when it is completed.

Champaign, Ill., has formed a "Citizen's Association" for developing the manufacturing interests of the city and county. J. R. Scott is President, and J. R. Treveli Secretary.

William H. Paige has resigned the superintendency of the Wason Car Works at Brightwood, Mass., and will shortly begin the manufacture of car wheels of his own patent in Springfield.

The American Watch Co., Waltham, Mass., have broken ground for an extension to their works 200 feet in length. When this is completed their product will be increased to 1,000 watches a day.

Warren Springer, says the *Industrial World*, manufacturer of general machinery, has just purchased two lots 100 x 160 feet adjoining his establishment on Clinton street, and will at once erect thereon a foundry for his own use.

The Allen Paper Car Wheel Company, of Chicago, have purchased a large tract of land at Morris, Ill., and will erect an extensive paper mill for the manufacture of straw board to be used in its paper wheel works at Pullman, near Chicago.

The Indianapolis (Ind.) Car and Mfg. Co., whose incorporation we noticed last week, will have their new shops completed by July 1, when 500 men will be put to work building freight cars. Riley McKeen is President, and Chas. S. Millard Supt.

The Blakeslee Manufacturing Company, Cuyahoga Falls, O., is a new concern organized to manufacture Blakeslee's improved forged nut machines, and heading machines for heading rivets, plow boats, track bolts, square and hexagon head bolts.

J. H. Sternbergh, of Reading, Pa., is preparing to erect a building, 190 feet long by 60 feet wide, adjoining his bolt and nut works, in which he intends to place three trains of rolls for the manufacture of merchant iron, suitable for bolts, nuts, rivets, washers, etc.

The Chicago & West Michigan R. R. Co. has bought two other railroads, and are moving all their shops to Muskegon, Mich., where they are putting up a large building for repair work. There is a great call for good machinists and other iron workers throughout the State.

Hart & Co., of Middletown, Conn., manufacturers of scissors, shears and skates, will remove their works to Rocky Hill, the people there having subscribed to $10,000 worth of their stock and agreed to exempt the firm from taxation for a time. The firm now employ 72 men, but will double the number.

Witherow & Gordon, of Pittsburgh, Pa., have contracted with James C. Warner & Co., of Nashville, Tenn., to build the latter a new charcoal furnace, to be erected within six months, in Hickman County. It will be 55 x 11 feet. It will first be blown in as a coal blast furnace, but two Whitwell stoves, 15 x 60 feet, will be immediately built after blowing in.

At the Reading (Pa.) Hardware Company's foundry, says the *Age of Steel*, a new machine has just been introduced for the separation of iron from the slag. It is constructed on the same principle as the farmer's winnowing mill, the slag being blown away and the iron falling down, the same as the chaff is blown away from the wheat. The machine is driven by steam power. Heretofore the loss of iron in casting was about 10 per cent., and it is thought it has been reduced to about 2 per cent.

The Cope & Maxwell Mfg. Co., Hamilton, O., write us: Business with us is remarkably good. We are continually adding to our already large works and plant, tools and appliances to facilitate the filling of the already large number of orders on hand. We are now working, in addition to the day force, a night gang until 10 o'clock at night, and as soon as more workmen can be had shall run all night. We have in hand one pair of compound condensing sewage pumping engines of 5,000,000 gallons capacity per 24 hours, for the Pullman Car Co., of Pullman, Ill.; one pair of condensing plunger pumping engines of 3,000,000 gallons capacity; one pair high-pressure pumping engines of 2,000,000 gallons capacity in 24 hours; four large tubular boilers of steel; boiler feed pumps and all connections, including pipes complete, for Springfield (Ohio) Water Works; one set of high-pressure plunger pumping engines of 3,000,000 gallons capacity in 24 hours, for H. C. Frick & Co., of Pittsburgh, Pa., to force water through ten miles of 12-inch pipe; one high-pressure plunger pumping engine for the high service supply of Cincinnati Water Works; one large power fire pump for the Friend & Forgey Paper Co., of Franklin, Ohio; one set of fire Cornish pumps complete, with connections; plungers, 12 inches diameter, 8 ft. stroke, for the Moulton Mining Co., of Butte City, Montana. The demand for all regular stock sizes of mining pumps, fire pumps, and boiler feed pumps is unprecedented, requiring our works to run to its utmost capacity. The prospect for trade for the future is very flattering indeed, and the tendency of prices are upward in order to keep pace with the increased price of labor and material. Skilled labor is very much in demand.

There are several new locomotive works, car and car wheel manufactories getting ready for operations in different parts of the country, as will be noticed by referring to our departments of "Manufactures" and "Newly-Incorporated Companies," for the last three or four issues.

Machinists' and Engineers' Supplies.

New York, April 7, 1881.

Trade remains good and dealers seem to be satisfied with the amount of business being done. Some of them complain of the slowness of manufacturers in filling orders.

A. Aller, 109 Liberty St., New York, has favored us with a neat illustrated catalogue of Schutte & Goering's steam jets and injectors, for which he is sole agent for New York, New Jersey and Connecticut.

Charles E. Ashcroft, 17 Batterymarch St., Boston, has been designated sole agent for the United States for Raynold's Table of Tangents for drawing expansion curves, and table or ordinates for drawing expansion curves.

There are to be some important changes in one or two machinists' supply houses in this city after the 1st of May.

Iron and Metal Review.

New York, April 7.

There is very little of interest to mention in regard Pig iron—Dullness seems to be the ruling feature. Prices, however, are maintained so far as we can learn, as follows: No. 1 $25 to $26, No. 2 $22 to $23, gray forge $20 to $21. Scotch pig is somewhat shaky at $24 to $24.50, for Coltness, $21.50 for Eglinton, $22 for Carnbroe and $22.50 to $23 for Glengarnock and Gartscherrie. Manufactured iron remains steady on the basis of 2.5c. for refined from store. Steel rails are quoted at $62 to $65, and iron rails, $48 to $50 at mill. Wrought scrap is sold at $30 to $31 for No. 1, from yard.

Boiler makers' supplies show a weak market. Quotations as follows: Tank Iron, 2¾c.; Refined Boiler Plate, 3¼c.; Shell, 3¾c.; Flange, 4¾c.; Extra Flange, 5½c.

Ingot Copper is held at 19c. to 19¼c. for Lake. Straits Tin sells at 20⅛c. to 20⅜c., and Common English, 20¼c. Pig Lead is quoted at 4¾c. for common, and 4⅞c. to 5c. for refined. Domestic Speiter rules at 5c. to 5⅛c., and Silesian 5¾c. to 5⅞c., with a dull market. Antimony is in light demand at 14¼c. to 14⅝c.

The dealers' buying price for Old Copper is 16c. to 17c; Copper Bottoms, 14c. to 14⅛c.; Old Lead, 3¼c.; and Old Composition, 13½c. to 14¼c. Old Cast Iron sells at $12 to $16 a ton, according to its character.

WANTED

Wanted.—A few Pattern Makers. The Hartford Engineering Co., Hartford, Conn.

Wanted, a few first-class Machinists. Brown & Sharpe Mfg. Co., Providence, R.I.

Wanted.—A first-class man skilled in running a Brown & Sharpe Universal Grinding Machine. The Hartford Engineering Company Hartford, Conn.

Wanted.—Experienced tool maker to work in tool room. Address, stating experience, wages wanted, &c., David W. Pond, Worcester, Mass.

A young man, a graduate of a scientific school at an eastern college, with several years experience in the machine shop and designing machinery, desires an engagement. Address M. Engineer, American Machinist, 96 Fulton St., N. Y.

Wanted, a Mechanical Draughtsman who is thoroughly acquainted with Locomotive work, and is accustomed to working up elevations and details. Address A.B., American Machinist Office.

Wanted, at the Pittsburgh Locomotive Works, a General Machine Foreman; a good position can be offered to the right man. Address D. A. Wightman, Supt., giving experience and salary required.

Wanted.—A young man of some experience in the construction of general machinery, to take charge of the "Engineering Dep't" of a large factory, situated near New York City. Best of references required. None but the active, sober and energetic need apply to, P. O. Box 34, Station "G," Brooklyn, E. D., N. Y.

THE LOWE PATENT
Feed Water Heater & Purifier,
FOR
Heating and Purifying Water for Steam Boilers.
Patented July 12, 1877.
HAS STRAIGHT TUBES.
SIMPLICITY, RELIABILITY AND EFFICIENCY,
At Less Cost
Than any other.
Write for prices and further information to the manufacturers,
Lowe & Watson,
BRIDGEPORT, CONN.

FOR SALE.
12 in. swing, back geared, screw-cutting Engine Lathe, with cross feed, turret tail stock. Address
MILTON M. SMITH,
Box 632, Ithaca, N. Y.

BOOKS. Descriptive Catalogue of Useful Books for Engineers sent free on application.
REED'S ENGINEERS' HANDBOOK to the Local Marine Board Examinations for Certificates of Competency. Eighth edition. $2.75.
WORKSHOP RECEIPTS. A reliable Handbook for the use of Manufacturers, Mechanics and Scientific Amateurs. By Ernest Spon. $2.00.
ALGEBRA Self-Taught. By Paget Higgs, M. A., D. Sc. $1.00.
BOILERS AND BOILER MAKING. A practical Treatise, illustrated by 1,163 engravings, and 50 plates, giving the forms of the most important Boilers made, with a chapter on Combustion and the Causes of Boiler Explosions. By N. P. Burgh. $30.00.
CASTING AND FOUNDING. Including descriptions of the Modern Machinery employed in the Art. By N. E. Spretson. 82 plates. $7.00.
STEEL: its History, Manufacture, Properties and Uses. By J. S. Jeans. Thick 8vo, cloth. $14.50.
ELECTRICITY: Its Theory, Sources and Applications. By John T. Sprague. $3.00.
ORNAMENTAL PENMAN'S, Sign-Writer's and Draughtsman's Pocket Book of Alphabets. 20 cents.
The above sent Free by Mail on Receipt of Price.
E. & F. N. SPON, PUBLISHERS OF SCIENTIFIC BOOKS.
446 Broome St., New York.

COOKE & CO., Formerly Cooke & Beggs,
Dealers in MACHINERY AND SUPPLIES.
6 Cortlandt Street, New York.
AGENTS FOR
The Waters Perfect Governor,
Having Adjustable Speed, Automatic Safety Stop, Sawyer's Lever, and Solid Composition Valves and Seats.
ALSO,
SUPPLIES
For Machinists, Railways, Mills, Mines, &c.
Please send for circular and state that you saw the advertisement in this paper.

THE
BOSTON BLOWERS
AND EXHAUSTERS,
ALL PARTS INTERCHANGEABLE.
Over Sixty Styles and Sizes.
Address for particulars,
BOSTON BLOWER CO., BOSTON, MASS.

FOR SALE.
ONE DOUBLE CYLINDER
WOODWORTH PLANER,
IN RUNNING ORDER, FOR SALE CHEAP.
G. & T. ALLING & CO., New Haven, Ct.

L. COES'
IMPROVED
PATENT SCREW
Wrenches,
Manufactured by
L. COES & CO.
Worcester, Mass.
ENLARGED
BAR JAW AND SHANK,
FERRULE MADE WITH DOUBLE BEARINGS.
Iron Tube Fitted to Shank, held rigidly in position by handle and nut.
No Back Thrust.
The HEAVIEST And STRONGEST Wrench in the Market.
WAREHOUSE:
97 Chambers & 81 Reade Sts.
NEW YORK.
DURRIE & McCARTY,
Sole Agents.

BRADLEY'S
CUSHIONED HAMMER
STANDS TO-DAY
WITHOUT AN EQUAL.
It approaches nearer the action of the smith's arm than any hammer in the world.
Bradley & Company,
SYRACUSE, N. Y.
[Established 1832.]

THE DUPLEX INJECTOR.
The best Boiler Feeder known. Not liable to get out of order. Will lift water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by
JAMES JENKS,
Detroit, Mich.
Damper Regulators and Gage Cocks. Murrill & Keizer, Balto.

J. STEVENS & CO.
CHICOPEE FALLS, MASS.
P. O. Box 1200.
Spring Calipers,
Dividers,
Surface Gauges,
Countersinks,
ETC.

BLAKE'S PATENT STEAM PUMPS.
MORE THAN 13,000 IN USE.
Adapted to Every Situation.
Send for New Illustrated Catalogue.
GEO. F. BLAKE MANF'G CO.
88 Liberty Street, NEW YORK.
44 Washington St., BOSTON.

KEARNEY & FOOT
Office, No. 78 Chambers Street, N. Y.
Full Weight Hand-Cut Files.
Manufactory, PATERSON, N. J.
The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.
NORTH RIVER IRON WORKS.
To Whom it May Concern: New York, May 1st, 1877.
We have used the Files made and re-cut by Messrs. Weinmann & Kearney for the past three years, and we know of no better recommendation than the fact that we are still using them.
FLETCHER, HARRISON & CO.
WINCHESTER REPEATING ARMS CO.
Messrs. Kearney & Foot, New York, New Haven, Conn., Nov. 1st, 1878.
Dear Sirs:—The Files you have been furnishing this Company have proved equal, if not superior, to any heretofore used. Yours truly, V. A. KING, Sup't.
We print on card board 10 x 12 in. "Instructions on the use of Files," which are intended for shop use. These instructions with our "Illustrated Catalogue of Files" we mail on receipt of 27 cents postage. To customers we mail a complete set free of charge.
KEARNEY & FOOT.

BETTS MACHINE CO., Wilmington, Del.
MANUFACTURERS OF
STANDARD GAUGES,
MEASURING MACHINES & ADJUSTABLE REAMERS.
STANDARD GAUGE.
Any size from ¼ in to 6 in.
CORRECTIVE GAUGE.
The disks are ground separately. Any combination of sizes can be made.
MEASURING MACHINE.
Sizes, 0 to 4 in., 0 to 12 in., 0 to 24 in. Can indicate to 1/10000 of an inch.
ADJUSTABLE REAMER.
Any size from ½ in. to 2½ in.
Size Maintained by Blade Adjustment.
Will Outlast the Solid Reamer.
Shank Ground to Standard Size.
KEEP SIZES RIGHT and thus CHEAPEN PRODUCTION.
SEND FOR CIRCULAR.